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JUNE 1st 1954

VOL. 9, NO. 4

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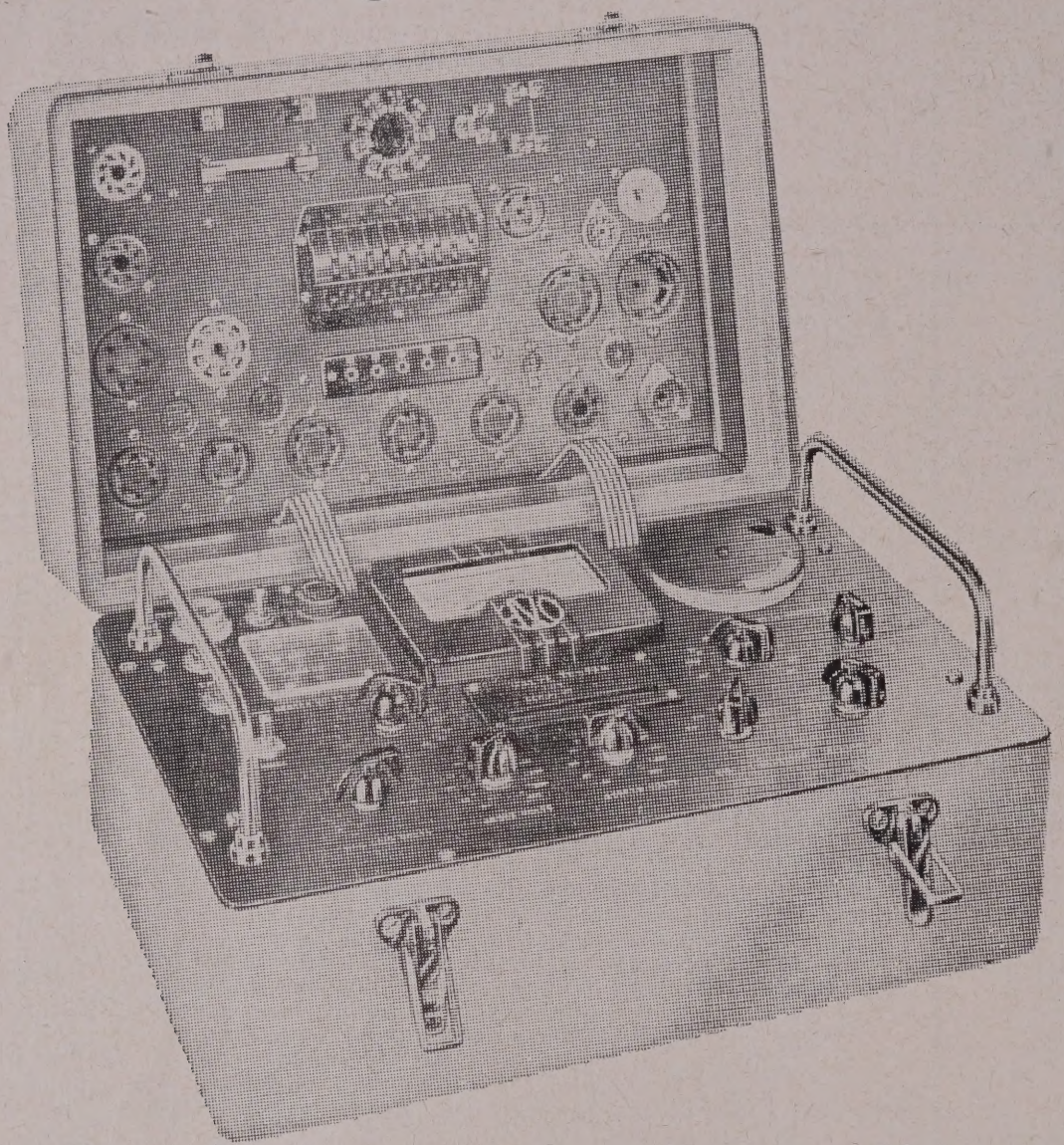
A simple "go/no go" tester which also gives detailed figures of valves' reaction to test



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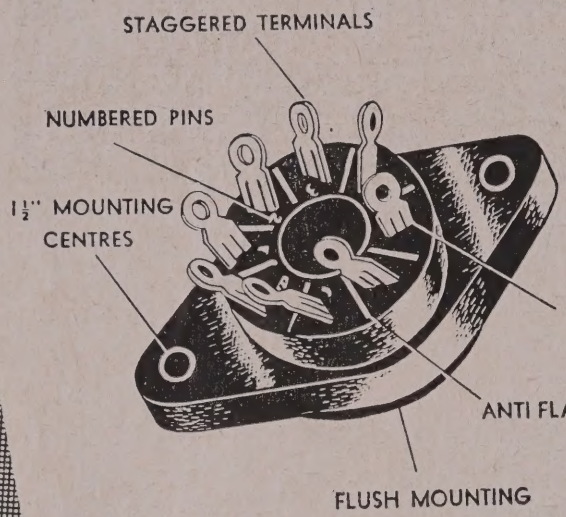

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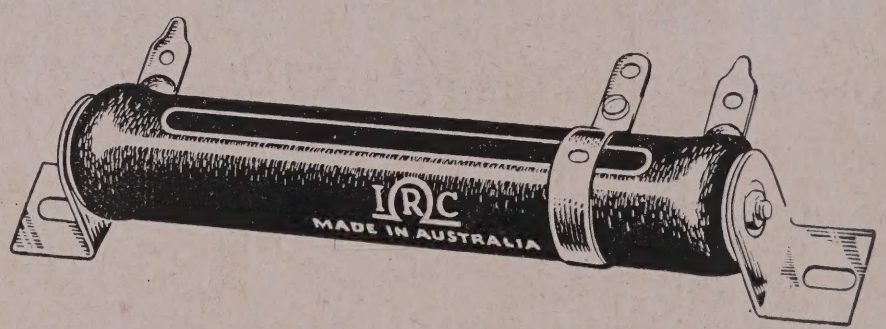

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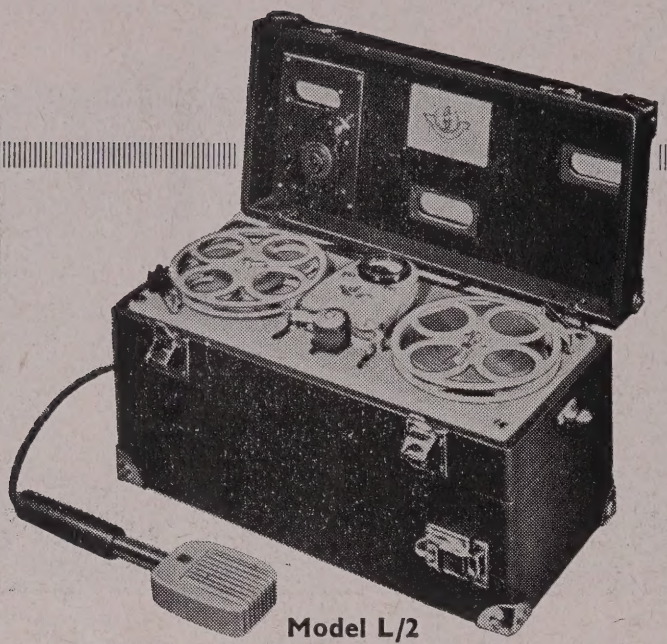
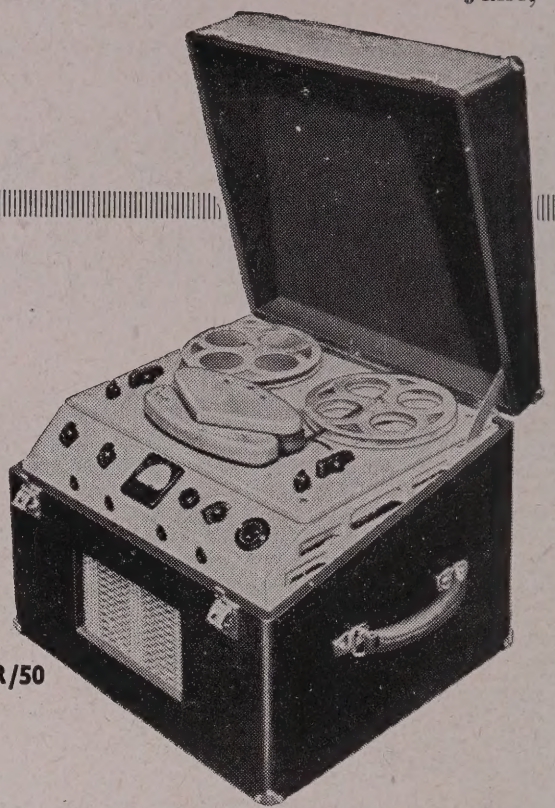


Model L/2



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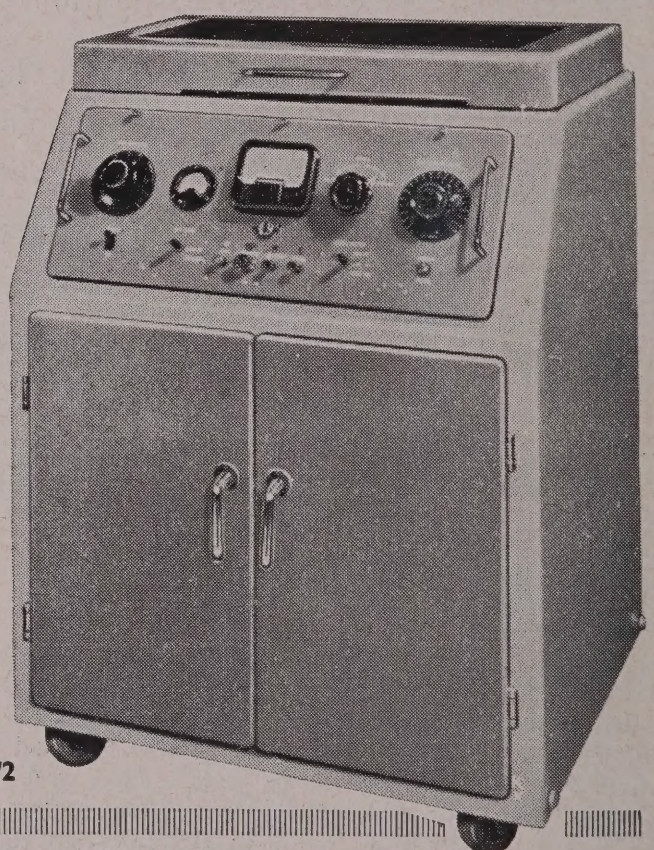

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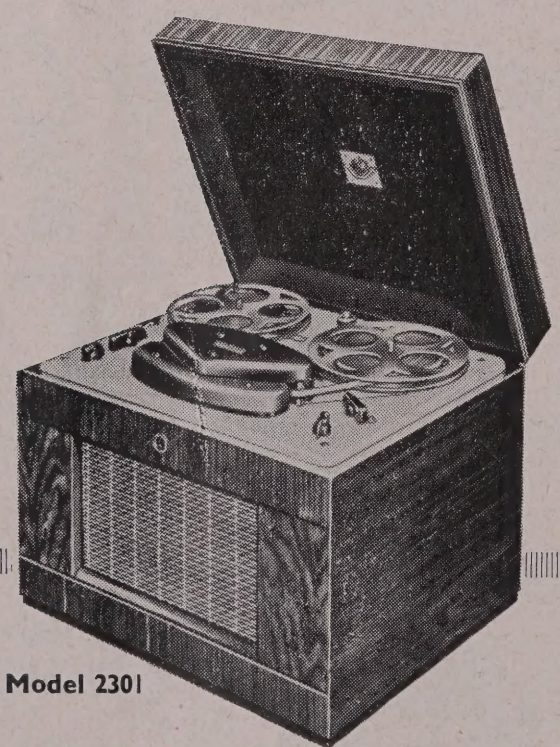

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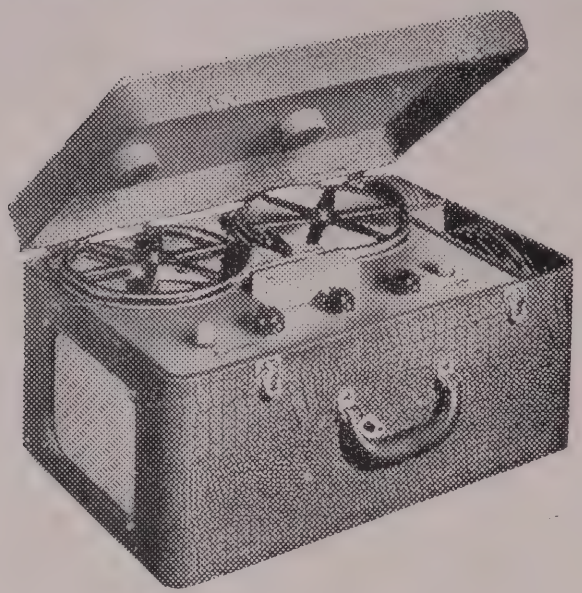

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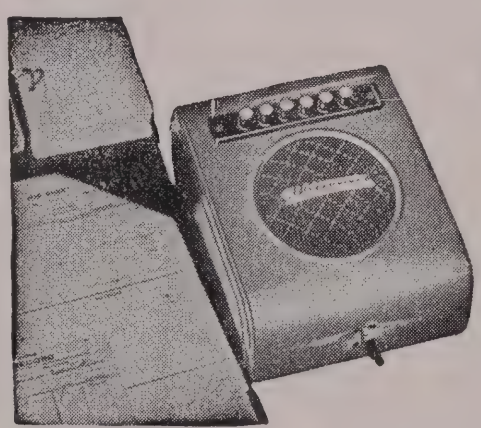

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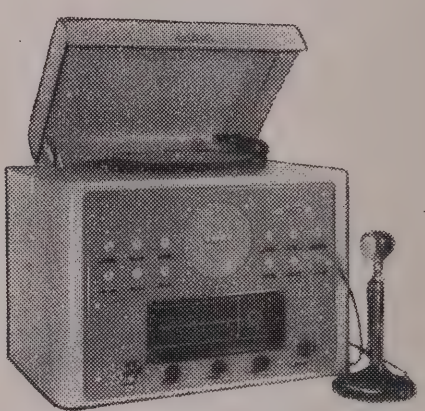

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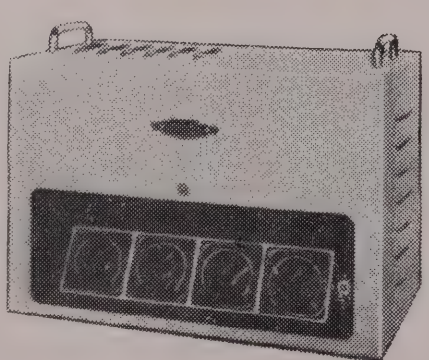

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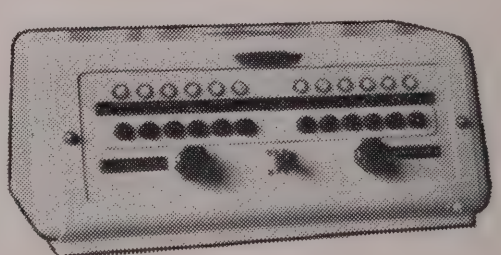

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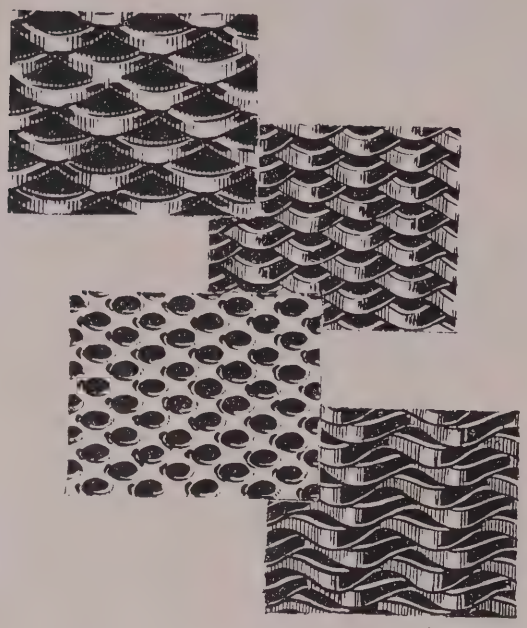

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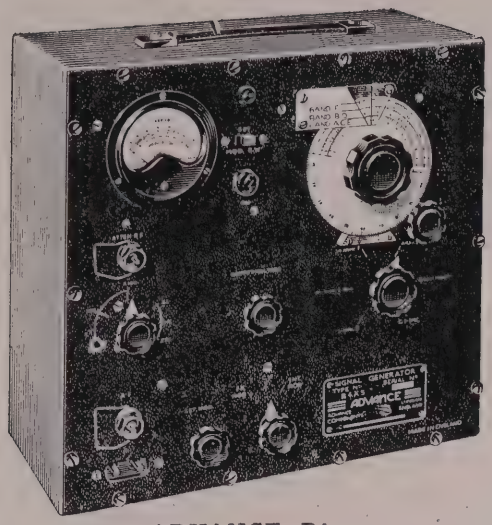

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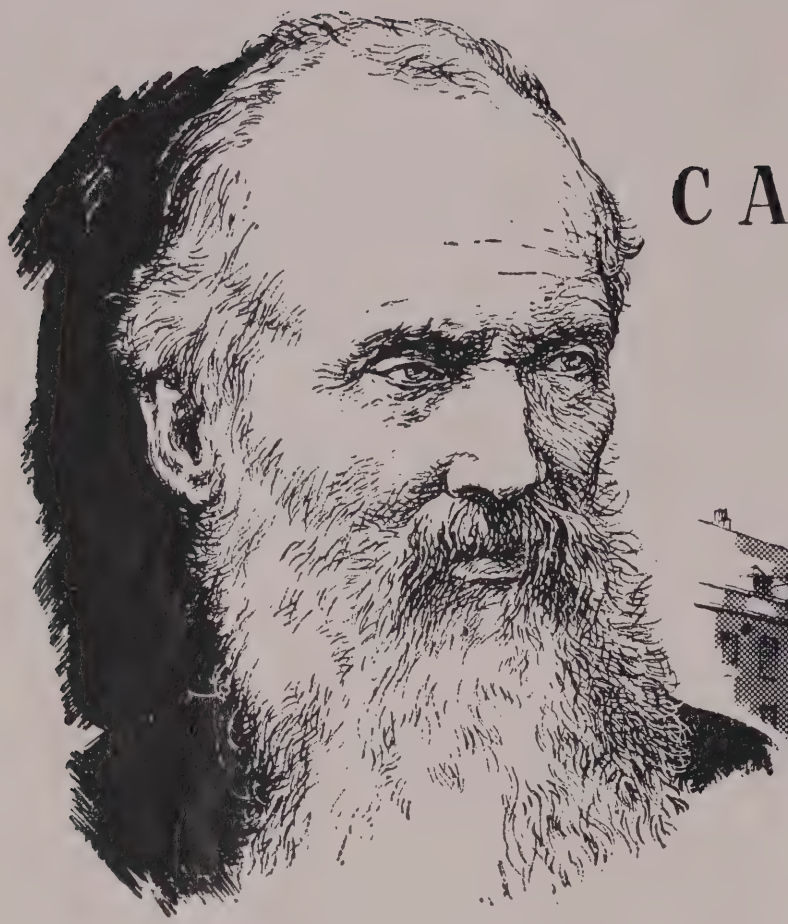

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Television In Australia And Here?

After a considerable amount of waiting on the part of all concerned, the Australian Royal Commission on Television has issued its report. The major recommendations are as follows:—

(1) Australia should have television as soon as possible.

(2) Both national and commercial networks should be set up.

The report also deals with such matters as the censorship of programmes and the estimated costs involved in establishing a service on a fairly wide scale. It is particularly notable that the A.B.C. estimates the cost of setting up seven stations, one in each of the State capitals, together with seven "regional" stations, as only £A5,000,000. Of this, £A3,500,000 is estimated to cover the total capital cost, including land and buildings, the remainder having been allowed to cover operating losses up to 1959. Moreover, the A.B.C. considers that it could have one station operating in Sydney within two years of receiving the word to go ahead.

As yet, these are no more than recommendations and estimates, and it is quite within the bounds of possibility that the administration might choose to ignore the Royal Commission's recommendations. Nevertheless, a telling blow has been struck those who, like the authorities in New Zealand, would have television delayed for an indefinite period. So far, there has been no news of the Australian Government's reactions, but if it is inclined to shelve the Royal Commission's report, it will have to produce good reasons for doing so. The situation in Australia is rather different from that which obtains here, in that there, TV has been a political issue for some two years. The Labour Government previously in power had gone so far as letting tenders for the first TV stations, but when the present Government took office, one of the first things it did was to scrap the whole scheme. Whether or not there is a change of government in the forthcoming Australian elections, it is quite possible that the Australian Labour Party will create a minor political storm should Mr. Menzies disregard the Commission's recommendations. Unfortunately, once TV does start across the Tasman, we will have little chance of receiving their transmissions, so that the question of Australian TV may seem to hold only an academic interest for us.

Be that as it may, the report of the Australian Commission might have a definite bearing on events in this country.

Mr. Algie has not said as much, but it is not illogical to assume that our Government's *laissez faire* attitude has been engendered partly at least by the indecision in Australia. It seems clear enough that the present Government wants no part in television, if only because of their very lame excuses for not doing anything about it, not forgetting, of course, their desire to await mythical technical developments which will "perfect" it! Our own idea is that their reluctance is purely a matter of £ s. d., at least as far as a State-operated system is concerned; what reasons they may have for setting their faces against any other sort of television service are known only to themselves. No doubt the New Zealand Government would have been very pleased had the Australian Royal Commission brought down an adverse report. As it is, they will have to think of a different reason for not starting it here, and we hope this time that it will be a better one than the "technical developments" story, or the supposed difficulties of coverage in Wellington.

As we write this, the daily newspapers have reported that the annual conference of the New Zealand Labour Party has recommended that TV and its introduction be made a party policy plank. It looks as though television might become a political issue here, too. We hope it does, because the present inaction could not be increased, whatever happens, and a little political wrangling may be just what is needed to start things moving towards the introduction of TV.

The question of costs will always be something of a stumbling-block, but we do not think it should prove an insurmountable one. The country is enjoying a period of unparalleled prosperity, in spite of the high cost of living, and if the capital cannot be found at such a time, it is hardly likely to be found in less auspicious circumstances. The time is ripe, if not over-ripe, for us to take unto ourselves this new public amenity which is one of the wonders of an electronic age, and which has much to offer civilization, just as broadcasting has already done.

Audio Amplifiers

A Medium-powered High-quality Amplifier

View of the amplifier, with its power supply built on the same chassis. Since the main controls are to be on the pre-amplifier chassis, to be described in next month's issue of R. and E., the volume control shaft can be cut off short and used as a pre-set, as described in the text.

INTRODUCTION

There has for a long time been a gap in the range of amplifier designs suitable for the amateur constructor. Several excellent circuits have appeared for amplifiers of the fifteen watt class. The Williamson amplifier comes into this category. Their results certainly leave little to be desired, but their cost is somewhat alarming. At the other end of the scale are little amplifiers with an output of three or four watts. Few of these have any pretensions to high-fidelity, but we ourselves have published one (A Low-powered High-quality Amplifier, August and December, 1950) which can genuinely claim that title. The trouble here is that four watts is barely enough electrical output to fill a large living room with sound, and certainly not enough if the amplifier is to be worked somewhat below maximum output in order to provide a little leeway for the unexpectedly high level that sometimes occurs.

What all this boils down to is that there is a need for a high-quality amplifier capable of producing something between these extremes. The subject of this article is intended to fill the gap, and we are sure it will be popular among our audio-minded readers. So without further ado, let us list the features that have been incorporated into this new amplifier system. We added the word "system" to the heading on purpose, because unlike most of our audio articles, this one describes a set-up comprising the main amplifier and its power supply, on one chassis, with the pre-amplifier and tone-control circuits on a separate small chassis, suitable for mounting and using at a point remote from the main amplifier. In this respect the arrangement follows the most modern practice, which these days invariably seems to separate the two parts of the system in this way.

FEATURES OF THE SYSTEM

(1) Output Stage

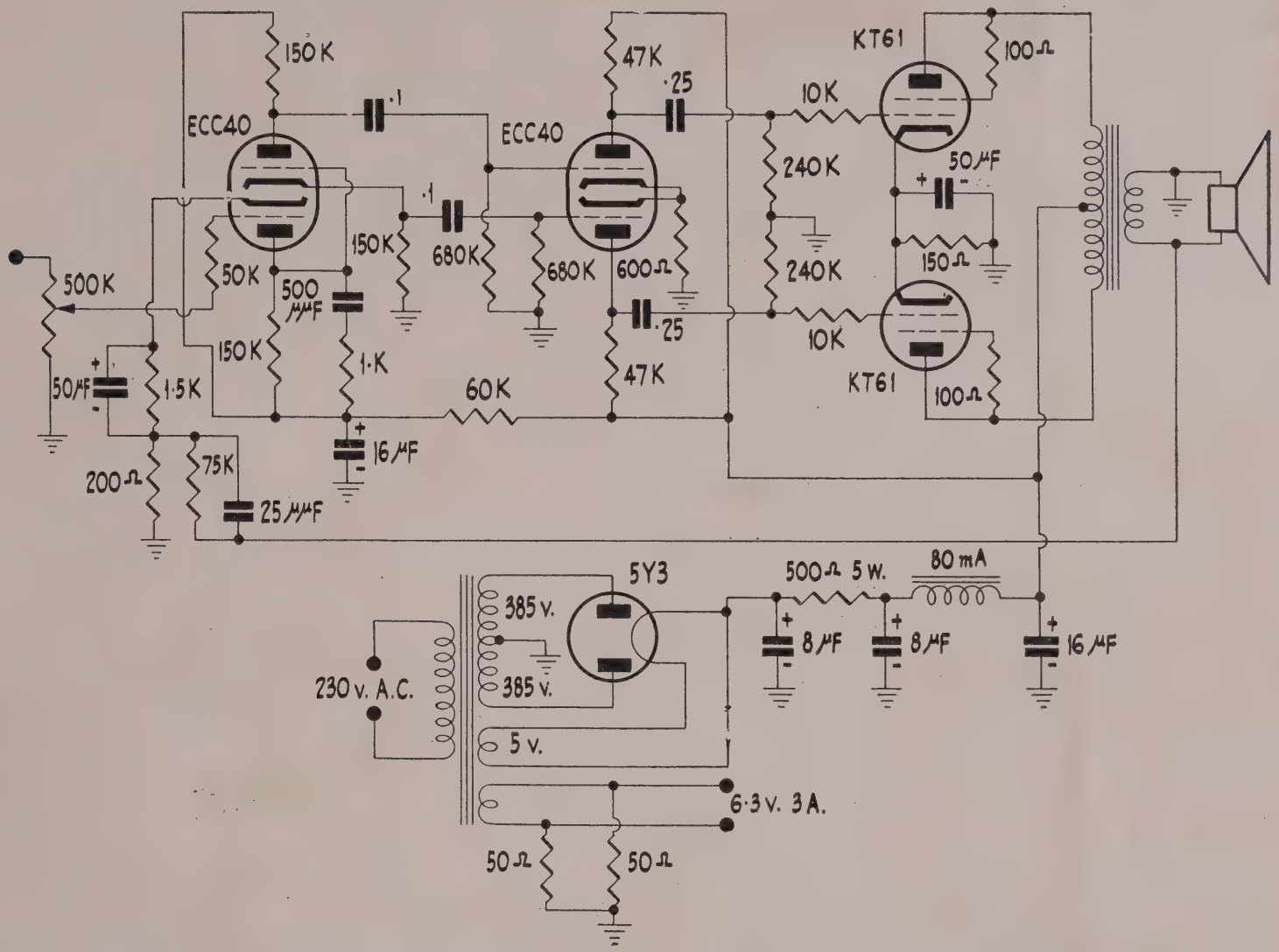
This uses a pair of push-pull KT61s, connected as triodes, with their maximum rated plate voltage of 350, which gives them an output of six watts.

(2) Voltage Amplifiers and Phase Inverter

Preceding the output stage is a push-pull voltage amplifier which uses the two halves of the Rimlock double triode, ECC40. This valve has been designed specially for audio work, with an amplification factor of 32 and a plate resistance of 11,000 ohms. With resistance coupling, and a supply of 350 volts it can give the required signal output for exciting the output tubes, with a distortion of only 0.3 per cent, and a gain of 20 times. The output tubes require only 8 volts, peak, for full output, so that the grids of the push-pull voltage amplifier need 0.4v. peak.

The input amplifier and phase inverter also make use of a single ECC40, in a circuit which employs direct coupling between the amplifier plate and the grid of the phase inverter. This circuit has to supply the 0.4v. peak for the following stage, and this is so small a figure that distortion can be entirely disregarded. The use of direct coupling eliminates one coupling condenser, which has a beneficial effect on the phase shift at very low frequencies, and helps to prevent motor-boating when feedback is applied round the amplifier. The voltage gain from the grid of the input stage to the push-pull outputs of the phase inverter is 27 times, so that if no negative feedback were used, the input signal required for maximum output would be 0.4/27, or 0.015 volt. This would give far too much gain for most purposes, and besides, extra amplification is needed to take care of the loss of amplification sustained when the feedback is connected. The margin of gain is great enough to allow substantial feedback to be used, while leaving enough for all likely contingencies.

Negative feedback is applied over the whole amplifier by means of a voltage divider connected to the secondary of the output transformer. The lower leg of this divider is a resistor of 200 ohms, and the lower end of the cathode resistor of the first half of the ECC40 is returned to the junction of the feedback voltage divider instead of to ground. This applies to the cathode of the voltage amplifier a portion of the output voltage which is determined by the sizes of the divider's resistors. The higher the value of the upper resistor, therefore, the less feedback, and vice versa. Protective circuits have been included which guard against the possibility of oscillation of the whole amplifier after the feedback has been connected. These circuits are not often seen in circuits designed for amateur construction, but are very well worth while. They take only a small number of resistors and condensers, adding almost nothing to the cost, and yet can mean the whole difference between a really high-quality job, and one which is unstable and therefore useless.



Circuit of the main amplifier and power supply. The output transformer is a 10-watt, high-fidelity type, matching 5000 ohms to the speaker voice-coil impedance. The chassis diagram will be found on page 20. On this diagram, the mounting hole for the volume control has been omitted, as the photograph shows a miniature potentiometer, which everyone may not wish to use.

(3) Pre-Amplifier and Tone Control Circuits

The pre-amplifier is one of our well-tried arrangements, using negative feedback round the valve to provide the response compensation that is needed for different types of record. It is a simple matter, too, to add extra positions on the control switch, which add greatly to the amplifier's usefulness. Thus, in addition to the two positions giving the correct compensation for 78 and L/P records, two more have been provided giving flat response, but two different degrees of amplification. In one the feedback is removed, giving the pentode stage its full gain, while in the other, the feedback is arranged to reduce the gain to the same average figure as obtains in the two Gram. positions, but without any low boost or top cut. The high-gain position will be found useful when a mocrophone is to be used, while the low-gain flat position will be handy for using the amplifier from a tape recorder or radio tuner. It can be seen that the circuit is therefore one of the most versatile in application that have appeared in these pages.

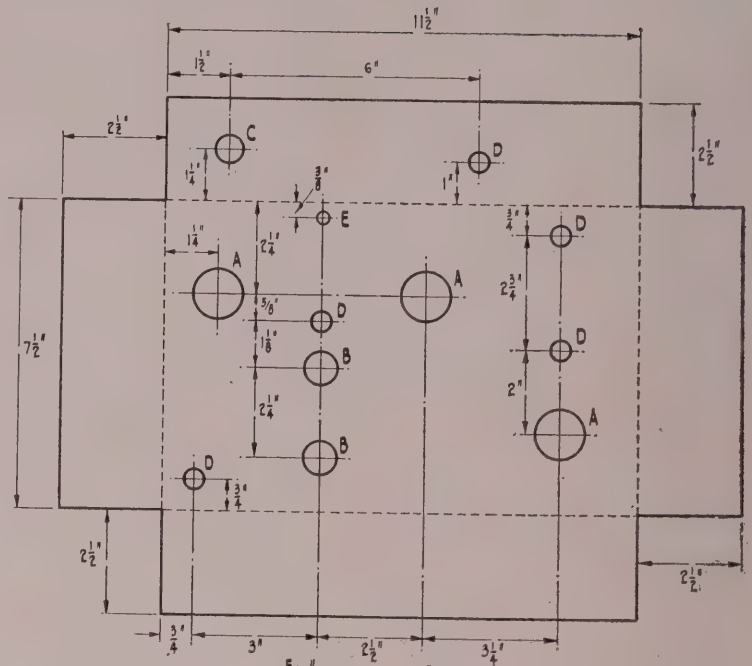
As for tone control, no attempt has been made to provide very high degrees of bass and treble boost and cut, as is done by some designers. We have previously criticized such pre-amplifiers as the Williamson on the score that too much response control is provided, making it very difficult to control the response in a rational manner. For instance, when the fixed compensating circuits give a flat response from the appropriate types of test recording, it is worse than useless to have a very high degree of bass cut available. If this is done, we have the manual and the fixed compensation working in opposition to such an extent that the one can completely over-ride the other, and it is not uncommon to find people listening to such an arrangement with completely irrational settings of the controls, simply because the ear takes too long to accommodate itself to changes in frequency response, for rapid adjustment of controls to give anything like the best answer. With such schemes, it is quite possible to play a given recording at different times, with different settings of the controls, and not know why the record, which sounded fine yesterday, sounds very poor to-day. This sort of thing can be completely avoided if more sensible response controls are provided for the user. For example, neither we

nor anyone else would suggest that some records do not need a little tinkering with the tone controls to get the best out of them. One will need a little more than the 'official" amount of bass boost, while another will need less top cut than the statutory amount. This can only be provided by making available the appropriate controls, but sensibly designed ones. Similarly, for low-level listening, extra bass boost is an essential, provided the user cannot take this to ridiculous lengths, through having been given a control with too much effect. The circuit given here therefore provides a control for adding a little extra bass boost for low-level listening, or for records that need it, and a similar small amount of top cut and top boost. It is particularly necessary to ensure that too much top boost is not made available, for no record is entirely free from distortion, and treble boost accentuates distortion, whether we like it or not. The reason is simple to find. Distortion comprises frequencies which in general are always higher in frequency than the original tones that are to be reproduced. Applying top boost means amplifying high-frequency components more than low-frequency ones, so that unwanted H.F. components are accentuated, which is the same thing as saying that distortion is increased. It should be noted that this effect is present, even if the treble boosting circuit itself is entirely free from distortion, Treble boost can only work without adding distortion if the input signal itself is entirely free from it. And this is something which in the nature of things cannot happen. This is the reason why the extent of boost possible with the present circuit has been restricted.

In many instances, it will be possible to wind the control up to full top boost without making any audible difference. If this happens, it could be understood that a boost control will make an audible difference **only** when the music contains frequency components within the frequency range being boosted. It is very common for the uninitiated to remark that a treble boost control does not appear to do anything at all! Nine times out of ten this will be because (a) there are no musical components in the boosted range when the remark is made, and (b) because, especially with L/P records, there is no surface noise to provide high-frequency sound on which the control can be observed to work!

CONSTRUCTION

The photograph shows a view of the main amplifier, and a working drawing for the chassis is on this page. The chassis used was a stock commercial one measuring 11½ in. x 7½ in. x 2½ in. This makes quite a compact unit without overcrowding in any way, while making room even for the output transformer. The output valves being placed one on either side of the latter, make room for the two ECC40s to be placed on the chassis in such a way that the circuit can progress from front to back without turning any corners. This lay-out also keeps the input section of the amplifier well away from the power supply components which occupy the right hand side of the chassis. There is nothing special about the way in which the amplifier is wired, point-to-point soldering of the components being the main method, helped out by the provision of insulated soldering lugs wherever necessary, to provide tie-points for resistors or condensers which do not have a valve pin on which to terminate one end. The only real care in wiring is given the input and feedback circuits. These are earthed at



the same point on the chassis, close handy to the first tube. In particular, the secondary of the output transformer is NOT earthed near the output transformer itself, but two insulated leads are taken from the lugs on the transformer itself back to the place where the feedback voltage divider is installed. Both resistors are mounted on a terminal strip, with one end of the 200 ohm resistor earthed to the same spot as constitutes the earth point for the input stage. Since the amplifier is to be used with a separate control panel (on the pre-amplifier chassis) we do not really need a volume control on the amplifier chassis itself. However, it is better to have one there, even if it is to be used only as a pre-set control. The idea is to have the main gain control at the output of the pre-amplifier, after setting the one on the amplifier chassis at such a point that even if the main control is turned fully on, the amplifier cannot overload. This saves a deal of trouble, because one does not always have to be wondering whether the level is a little too high for the amplifier on the loudest passages of music. The point can be cleared up once and for all when the pre-set control is adjusted, and then conveniently forgotten.

(To be concluded).

ROLA Ellipticals

SPECIFICATIONS

MODEL	POWER HANDLING CAPACITY (watts)	CONE	FUNDAMENTAL DIAPHRAGM RESONANCE 5 c.p.s.	FREQUENCY RANGE c.p.s.	VOICE COIL IMPEDANCE Ohms at 400 c.p.s.	PRINCIPLE DIMENSIONS (Inches) Overall	Front to Rear	Baffle Opening
5-7H	4	F86	115	110-6,000	3.5	$7\frac{3}{8} \times 5\frac{1}{8}$	$2\frac{7}{8}$	$6\frac{3}{4} \times 4\frac{5}{8}$
5-7L	5	F86	115	110-6,000	3.5	$7\frac{3}{8} \times 5\frac{1}{8}$	$3\frac{1}{8}$	$6\frac{3}{4} \times 4\frac{5}{8}$
6-9H	4	F70	115	110-5,500	3.5	$9\frac{7}{32} \times 6\frac{11}{32}$	$3\frac{5}{16}$	$8\frac{3}{4} \times 5\frac{3}{4}$
6-9L	5	F70	115	110-5,500	3.5	$9\frac{7}{32} \times 6\frac{11}{32}$	$3\frac{1}{2}$	$8\frac{3}{4} \times 5\frac{3}{4}$

TRANSFORMER: Type D, attached, or detached for chassis mounting.

Circuits for the Experimenter

10 Kc/sec. Whistle Filters

One of the problems of obtaining high-fidelity reproduction for broadcast stations is the 10 kc/sec. whistle that can frequently be heard when the receiver has been given a wide-band response, in order to preserve the excellent high-frequency reproduction provided by our broadcast stations. This whistle is most disturbing when it does occur, and there are only two possible ways of eliminating it. The first is to reduce the bandwidth of the R.F. end of the receiver or tuner, until the 10 kc/sec. whistle is no longer sufficiently strong to be audible. However, for tuners such as we are discussing, this is the worst possible solution, because it completely defeats the purpose of the tuner! This leaves only one solution, but luckily, this is an entirely practical one. It is to insert into the amplifier a trap circuit, tuned to 10 kc/sec., which will cut a deep and narrow "hole" in the response curve at this frequency. Until the advent of special core materials like powered iron-dust, and Ferroxcube, such filters were not nearly such a practical proposition, because it was necessary to use air-cored coils. This came about because if the required inductance were obtained with a relatively small winding, by the expedient of using a laminated magnetic core, such as would be used for a small audio transformer, the iron losses would be great enough to prevent the resulting inductor from having a great enough Q. A rejector circuit must have a very high Q if it is to produce a useful amount of attenuation at the frequency to be removed. Also, if the Q is low, one might obtain enough rejection at the tuned frequency, but at the expense of causing much too wide a hole to be cut in the audio response. This would mean that we would have considerable loss of response at frequency within a wide range, say from 5 kc/sec. to 15 kc/sec., and the audible result would be very similar to that obtained by cutting off everything above 5000 c/sec. It is essential, therefore, to have a high-Q rejector circuit. With the components and circuit about to be described it is possible to reduce the strength of the 10 kc/sec. whistle by 20 db. (a factor of ten times) while introducing no loss in response below 9000 and above 11,000 c/sec.

Let us see how this desirable result is brought about.

A PRACTICAL CIRCUIT

Fig. 1 shows one good arrangement that can be used in practice for eliminating a 10 kc/sec. whistle. But before we go on to describe its action we should perhaps indicate the cause of these whistles, and the sort of one that can be eliminated with a circuit of this kind.

The whistle, it should be realized, is not a fault of the receiver or tuner concerned, except in so far as its selectivity is not great enough to prevent it from appearing in the audio output. But since the whole idea is to obtain audio response up to 10 kc/sec., the lack of selectivity can hardly be regarded as a fault in any case. It is merely there because broadcast stations are spaced throughout the band at 10 kc/sec. intervals. Should the adjacent station to the desired one be putting in a strong signal, the two carriers produce a 10 kc/sec. heterodyne note as soon as the detector acts on them, and that is that. No artifice that can be used in the detector circuit will prevent the heterodyne from appearing, because it is produced by the normal action of the detector. Now superhet. receivers often produce whistles that are due to entirely different causes, and which can legitimately be regarded as faults of the receiver itself. Fortunately, however, these are easily distinguished from the genuine

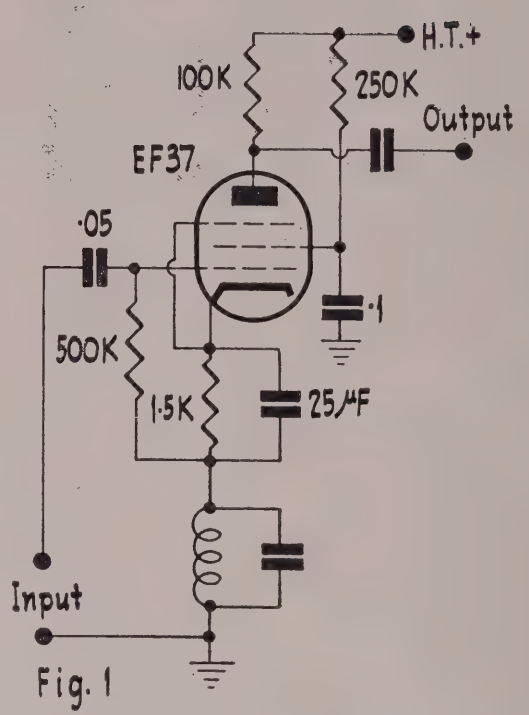


Fig. 1

The tuning coil is described in the text, and for 10 kc. whistle rejection, the condenser should have a value of 0.01 μf.

10 kc/sec. note produced by the carriers of two adjacent stations. As the receiver is tuned through the station we wish to receive, the genuine 10 kc/sec heterodyne will not change its pitch. The only thing that could change it would be if one of the two stations concerned altered its frequency slightly. Luckily, broadcast stations have to control the frequency of their carriers to within a few cycles per second, and as a result, the 10 kc/sec. beat note can never be more than a few cycles from the theoretical frequency of 10 kc/sec. This is what enables us to use a very sharply selective circuit for removing it, for we know that it will never be likely to drift away from the frequency to which we tune our rejection circuit. Other superhet whistles always change in frequency as one tunes the set through them. Consequently, it is not possible to eliminate them by the wave-trap method. Incidentally, the 10 kc/sec. beat between stations *will* be received on a T.R.F. tuner, which by its nature cannot produce any other sort of whistle, as can a superhet.

The circuit is a very simple one. Basically, it is nothing more than a resistance-coupled amplifier stage, with a tuned circuit connected in a grid-cathode circuit in the appropriate manner. Acocrdingly, it would in many cases be possible to install the tuned circuit in an existing amplifier stage, which would preferably be the first one in the amplifier. It would be a very simple matter to connect a short-circuiting switch across the tuned circuit, making the amplifier stage a normal one for occasions when the filtering effect is not needed.

Adjusting the tuned circuit is a very simple process, consisting simply of tuning it with the condenser until the whistle is at its minimum intensity.

The arrangement shown actually gives more selectivity than the tuned circuit alone is capable of giving. This is because the rejection acts by means of negative feedback. At the frequency to which the circuit is tuned, it

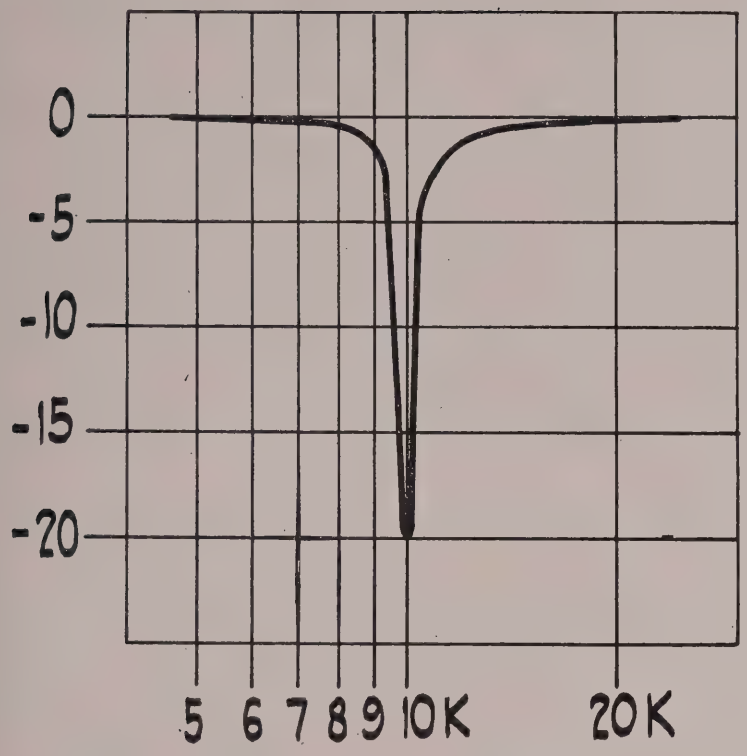


Fig. 2

has the same effect on the stage gain as if a large resistor of 50k. or more, were connected at the same place in the circuit. This is equivalent to having a large cathode load resistor, with the result that the stage gain is reduced to little more than 1. At frequencies off resonance, the impedance of the tuned circuit is less, and so causes less negative feedback and less reduction of gain.

The performance of the circuit is illustrated in Fig. 2, which gives an idea of the narrowness of the hole cut in the response curve. It can be seen that the response is back within 2 db. of the average level at frequencies very close to the resonant point.

Before leaving the circuit, we should perhaps give some idea of how different circuit values will alter the performance. If the pentode load resistor is raised to, say, 300k., the effect is to reduce the depth of the hole without appreciably affecting its width. This is because the gain at resonance depends on the ratio between the load resistance and the effective resistance of the tuned circuit. The latter is not changed when the load is increased, so that there is a smaller degree of negative feedback, and therefore less rejection. On the other hand, if the load resistor is decreased, this cannot give much more rejection than shown in Fig. 2, so that a load of 100k. is about the best all-round value to use. It is possible to get more rejection than this by increasing the load resistance, *provided* that the impedance of the tuned circuit is increased at the same time. This can be done by using a higher L/C ratio, and in this way it should be possible to get something like 30 db. attenuation.

OBTAINING THE CORRECT INDUCTANCE

The correct core to obtain is a Ferroxcube, type D14/8. This is a miniature core only $\frac{5}{8}$ in. in diameter, and is provided with a small bobbin. This should be wound with 400 turns of wire. Owing to their extremely small size, it will be necessary to use wire of 42 (or smaller) S.W.G. The cores are in two halves, and these totally enclose the

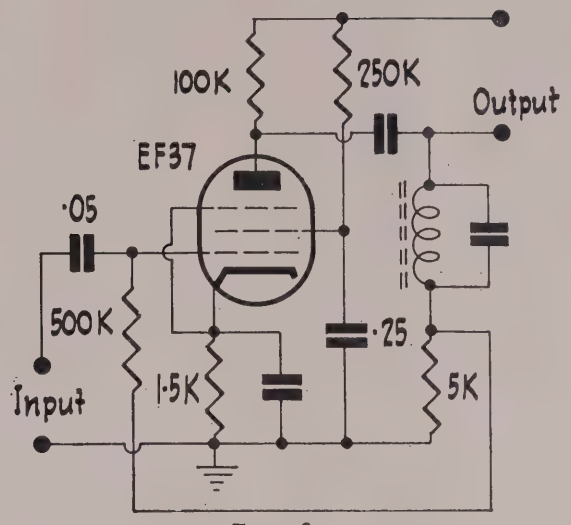


Fig. 3

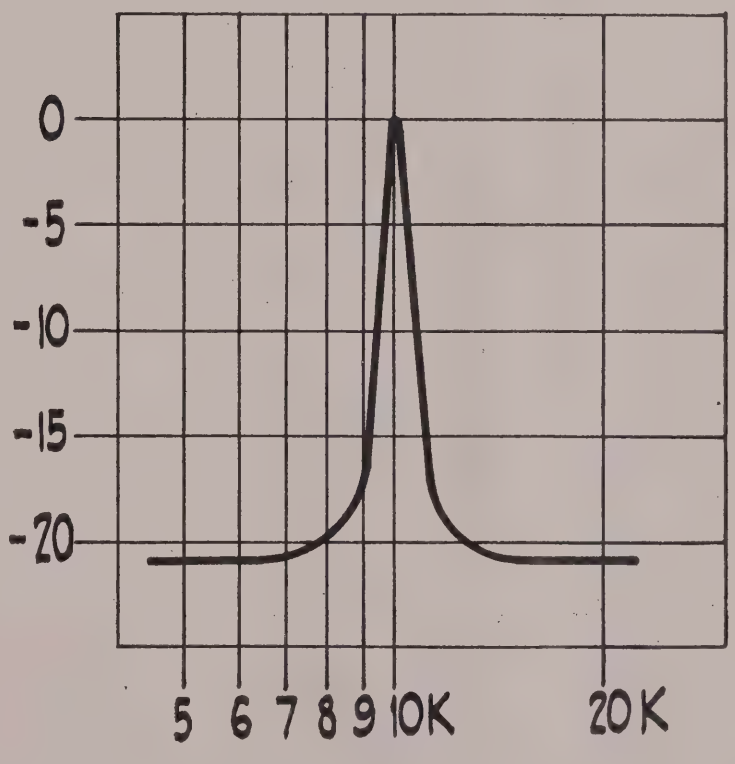


Fig. 4

bobbin except for a small hole in the side, through which the wires can be brought. There is a further hole through the centre of the core, through which a small brass mounting bolt can be taken. This can serve both to mount the core to the chassis, and to hold the halves firmly together. To reach 10 kc/sec. with the winding and the capacity specified, it will be necessary to reduce the inductance, by making a gap in the core. The inductance could be reduced by putting on fewer turns, but the use of a small core gap is preferable, because it will prevent the D.C. plate current of the valve from partially saturating the core, and will also stabilize the inductance against temperature changes. Washers can be made from thin paper, and placed between the core halves before the mounting bolt is screwed up. The inductance can be

adjusted by adding or subtracting one thickness of paper. In the case of our experimental ones, two thicknesses of cigarette paper were sufficient. The inductance is very sensitive to small changes in the length of the air-gap thus provided, so do not use heavy paper on the score that very thin stuff won't make much difference. Adjust the gap in this way until 10 kc/sec. comes within range of the padder condenser. The coil can then be permanently mounted, and final adjustment made with the condenser.

A SELECTIVE AMPLIFIER FOR AUDIO FREQUENCIES

In Fig. 3 is shown another use for the midget pot-type cores that we have specified for the rejector circuit in the last paragraph. By slightly re-arranging the circuit, it can be made to act as an acceptor, or more conventionally, a tuned amplifier. Such an amplifier can find uses in receivers for C.W., in control circuits based on selecting certain tones from the output of a receiver or amplifier, and for other special purposes. Again we have a feedback circuit, but this time, the tuned circuit is used in the opposite sense. The amplifier output is applied to a "voltage divider" made up of the tuned circuit, and a 5k. resistor. At resonance, the tuned circuit again looks like a resistor of very high value, so that the negative feedback is a minimum, and the gain is a maximum. At frequencies off resonance, the impedance of the tuned circuit is much lower than at resonance, so that there is a very high degree of negative feedback, and the stage gain is very low. Fig. 4 shows the response curve of this circuit when the tuned circuit used was the same one as is specified in the previous article. For other frequencies, the inductance and capacity will have to be changed, of course, with higher inductances being used for lower frequencies, if the selectivity is to remain of the same order.

Equipment from the Birthplace of High-definition Television

By L. MARSLAND GANDER, Radio Correspondent of the "Daily Telegraph" (London)

During a recent six weeks' tour of North America, I was often asked: "Is there any television in England?" I was able to answer, with some pride, coupled with a certain pained surprise, that the United Kingdom was the birthplace of high-definition television transmitted as a public service.

Moreover, though many minds in many countries—including the United States—contributed pieces to the jigsaw of television invention, Britain gives the credit for the first practical demonstration to the Scot, John Logie Baird. This was in London in January, 1926.

There can be no dispute that it was the British Broadcasting Corporation which, ten years later, inaugurated the first high-definition public television service in the world from the old Alexandra Palace on the heights of Muswell Hill, in North London. Although the records of the Federal Communications Commission in the United States show that in 1937 some 17 experimental stations were operating there, none was offering a regular programme service to the public on the same lines as the British Broadcasting Corporation's station.

It was not until April 30, 1941, that the Federal Communications Commission authorized commercial television operations to start on July 1 of that year. Even this proved premature, and it was only after the war, in 1947, that the American television boom began.

Three-quarters of Population Reached

Meanwhile, after Britain's flying start, the outbreak of war in 1939 brought her public television to an end. It was resumed in 1946, and, in spite of all difficulties, television is flourishing today in the United Kingdom, which is far ahead of any other country in Europe in this development, and has nearly 3,000,000 television receivers in use. Transmitters already built can reach more than 40,000,000 out of 50,000,000 inhabitants, and it is probable that by the end of 1955 only about 3 per cent. of the population, or 1,500,000 people, will be out of range of television.

While the country does not have the wide choice of television programmes offered in the United States, and its industry is small by comparison, long experience and home craftsmanship have produced tricks of the trade in Britain that have won the admiration of American visitors. Perhaps the most important recent tribute was that of Mr. Jack Gould, Radio Editor of the "New York Times." Impressed, as many Americans were, by the British Broadcasting Corporation's transmission and telerecording of the Coronation ceremony, he visited the United Kingdom to discover what lessons might be learned. One such lesson was that the Corporation has developed the technique of outside broadcasting considerably further than in the United States. The number of its outside broadcasts is also far greater.

Mr. Gould was immensely struck by the quality of the film transmissions as broadcast to television screens. He was strongly outspoken in his coments, writing: "The quality of the production of the best British films made for television is altogether startling. It is so much better than ours that it could have vast implications in American radio."

His tribute is all the more remarkable because the technical standards of United States television are, theoretically speaking, slightly better than those of the British Broadcasting Corporation. My own observations of American television fully bore out Mr. Gould's opinion.

The importance of good film transmission is, curiously enough greater in the United States than in Britain because a far larger proportion of the programmes is devoted to it. More than half of Hollywood's output now consists of short feature films and weekly shows put on film for television. As new stations spring up, the demand for films to fill the empty programme spaces must grow.

The Flying Spot Film Scanner

The film transmitting apparatus which has earned such handsome encomiums is known as the flying spot film scanner. Electric and Musical Industries, one of the firms that have supplied flying-spot scanners to the British Broadcasting Corporation, has recently demonstrated equipment showing the application of the technique to American standards. There is no question that it produces a brilliant clarity of picture and an immense wealth of detail in the reproduction, far better than anything I saw on American screens during my journey from coast to coast.

Incidentally, this firm is generous with the knowledge of its scientific alchemy. Its offshoot, E.M.I. Institutes, under the direction of Professor Harry F. Trewman, has an elaborate and carefully planned scheme for the training of young technicians in all aspects of electronic engineering. At present, 200 are under instruction, of whom 67, nearly all scholarship winners, are on a four-year course. Theoretical training is linked with practical factory experience. Of the trainees, 40 or 50 are from other parts of the world, ranging from Hong-Kong to the United States and including such countries as Pakistan, India, and Israel.

Some United Kingdom television products are being sold to the United States for reasons of quality and price. The Pye Company, of Cambridge, England, for instance, is regularly dispatching by air cameras and ancillary equipment for sale in the United States through General Precision Laboratories Inc. More than 20 stations throughout America are now using Pye camera equipment. The big increase in the number of small independent ultra-high-frequency stations, which often have limited resources and money, should offer further opportunities for the use of studio equipment from Britain.

Marconi's, of Chelmsford, England, supplied cameras to the United Nations headquarters in New York, studio and mobile equipment for the Montreal and Toronto stations of the Canadian Broadcasting Corporation and its Ottawa transmitter. The transmitter, studio, and mobile equipment for Vancouver were also ordered from the same firm. Manufacturing this apparatus to American standards, or those of any other country, presents no difficulty.

Home Recording

TAPE VERSUS DISC

(Reproduced by permission of the publishers of "Electrical Industries Export," 6 Cavendish Place, Regent Street, London).

The large number of makes of recording equipment on the market today is indicative of the great interest which is being taken in this subject. Recording machines, mainly used for the dictation of letters have been in use in commercial offices for many years, but it is only comparatively recently that facilities have been available for recording in the home.

In the early recording machines, wax discs or cylinders were used almost exclusively, and, indeed, still are very widely used. An alternative system is the use of a magnetic tape as a recording medium.

The relative merits of long-playing disc records and magnetic tape for sound reproduction in the home, recently formed the subject of discussion at the Institution of Electrical Engineers, Savoy Place, London.

This was opened by Mr. H. F. Smith, Editor of "Wireless World," who observed that it can be assumed that both disc and magnetic-tape recordings are capable of giving better than acceptable quality of reproduction for domestic use. In comparing the two, considerations of convenience and practicability weigh heavily; even more important is the relative costs of reproducing equipment and recordings.

To obtain good results and long life from modern long-playing discs and light-weight pick-ups, a fair measure of manual dexterity is called for. The original tape recorders and reproducers, with complicated tape threading arrangements, were certainly unsuited for use by the unskilled, but the modern domestic type, with "drop-in" tape threading and easily controlled winding devices, is probably easier to operate than a disc reproducer. Operation of tape machines could be made still easier—but at greater cost—by providing "casettes" with storage and take-up spools mounted together on a frame to drop on to the capstan spindles.

Tape seems to be at some disadvantage for recording more than one item on the same run. Without the highly accurate (and costly) indicating devices built into "professional" equipment, it is not possible to find with certainty the starting point of the item required.

There is little difference in the inherent cost of the simplest possible tape reproducer and a disc machine of comparable performance. But, as things are, the reproducer is almost always combined with facilities for recording. This means provision of supersonic bias, an erase head and generally more complicated switching and input devices. A combined recorder-reproducer is therefore more costly than a disc reproducer, in so far as the two can be compared. The user of the combination tape machine can, however, make his own recordings, either from broadcasting or other sources.

Ready-recorded tapes have not yet been produced commercially in Britain, but it seems likely they might be more costly than discs. That statement is based on the fact that bare (unrecorded) tape at present costs about as much as ready-recorded long-playing discs per unit playing time, assuming $7\frac{1}{2}$ in./sec. as the tape speed. There is, however, a tendency to reduce tape speed to $3\frac{3}{4}$ in./sec., and this has been standardized in Germany by one of the principal manufacturers. At this speed the high frequency response is probably enough for most domestic needs, and is as much as can be catered for in low-and medium-priced equipment.

Another economic aspect is the relative life of tape and disc recordings and their susceptibility to accidental damage. There can be no doubt that the tape will withstand, without deterioration, a vastly greater number of playings than the most carefully handled disc, but, on the other hand, the storage life of recorded tapes is not necessarily unlimited. It has not yet been in use long enough for precise figures to be available, but estimates of life for some types of base are as low as about five years without deterioration. Stored tape is affected by so-called "printing" in which the induction is transferred to adjacent layers on the spool, a process which is accelerated by fluctuations of temperature and stray magnetic fields. Strong magnetic fields may even obliterate part or all of the recorded contents.

A library of tapes recorded at present-day speeds would need much greater storage space than long-playing discs for the same playing time, even with two-track recording. No appreciable saving in space could be made by reducing tape thickness, even if this were possible. Spools of tape are not so easy to handle or to store for quick reference as are discs.

Much of the ensuing discussion centred round economic considerations. It was appreciated that these could not be entirely divorced from such factors as ease of handling, quality of reproduction and foolproofness. As far as the relative costs of specific items of equipment were concerned, however, it was thought that the turning mechanism, reproducing-head and amplifier for the tape machine were likely to be more expensive than those for the record player.

The relatively high cost of the magnetic tape was mentioned, but it was also pointed out that the length of tape used per foot of track was considerably smaller for multi-track tapes than for single-track tapes.

It was claimed by one speaker that, in the long run, higher maintenance costs were likely to be incurred for the disc-reproducer as compared with the tape-recorder-reproducer.

Several speakers were of the opinion that tape recorder-reproducers were in some respects more difficult to handle than the disc machines; the need for rewinding and the possibility of tape being spoiled by "spilling" or otherwise were cited as examples

of this. On the other hand, it was pointed out that plastic tapes were more durable than the average long-playing records, and called for rather less care in handling.

Where it was required to select accurately and to reproduce intermediate portions of recorded programmes, the disc recorder was said to have advantages, but against this it was held that, unless great care was exercised, attempts to register the needle on particular intermediate spots on discs might easily result in damage to the record and the needle.

Attention was also given to the questions of storage and inspection. "Print-through" difficulties and deterioration of tape made the storage of tape more difficult than that of the long-playing disc counterpart. In answer to this it was pointed out that "print-through" troubles could be greatly reduced if regular respooling were carried out.

Inspection for flaws was likely to be simpler in the case of discs, for which visual inspection was normally sufficient, than for tapes for which electrical inspection was more often required.

In answer to a question it was stated that possible reasons why ready recorded tapes were not commercially available and hence why tape-libraries had not been widely set up were (a) that there had been no general standardization as far as running speeds and position of track on the tape were concerned, and (b) although methods of duplication on the recordings were in operation, some difficulty had been experienced in duplication on a really large scale.

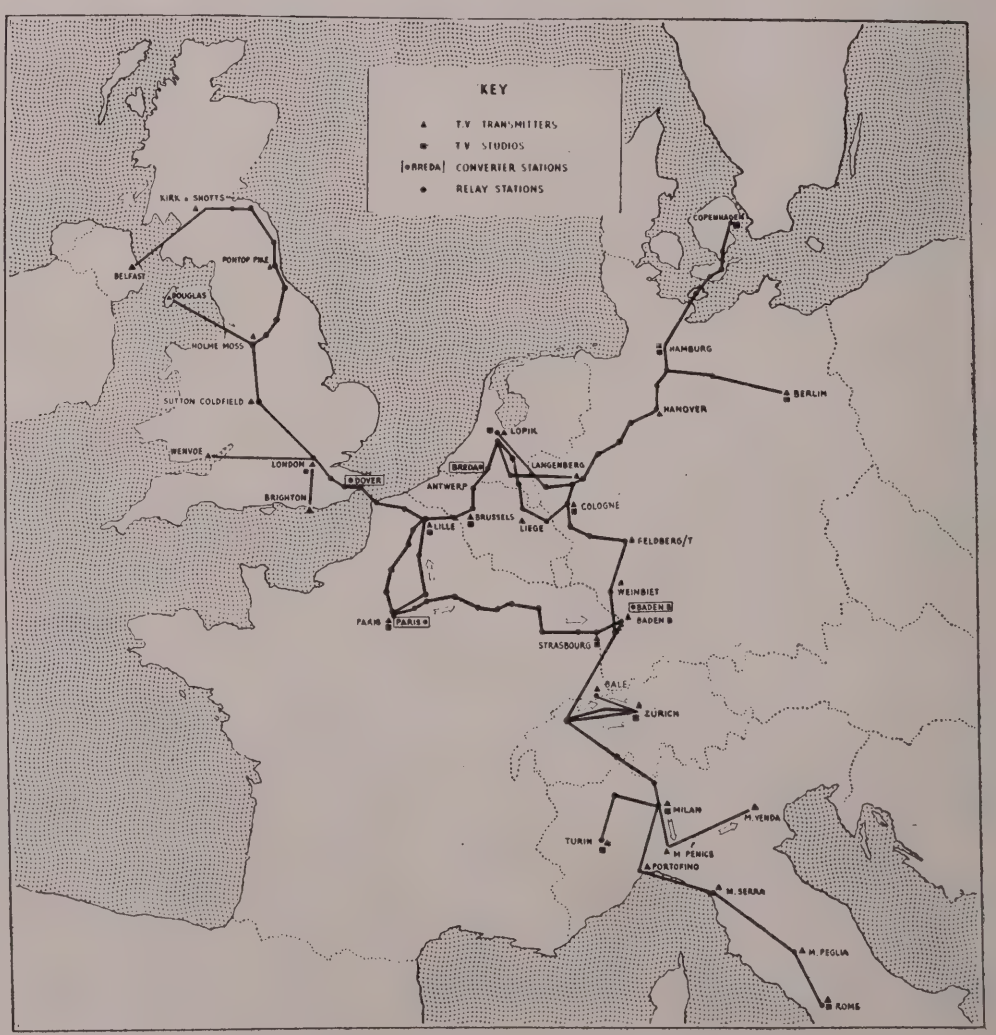
During exchanges of opinion on the relative merits of the two systems in so far as the mechanics of recording were concerned, it was held that an advantage of the tape system was that it lent itself more readily to editing.

"EUROVISION"
EUROPE'S TV 8-WAY HOOK-UP

From June 6 to July 4 eight countries will be exchanging television programmes. They are Belgium, Denmark, France Germany Holland, Italy Switzerland and the United Kingdom.

Last year B.B.C. pictures of the Coronation were seen in France, Belgium, Holland and Germany. This year Switzerland, Italy and Denmark are being joined up by microwave links and programmes will be transmitted in turn from each country to all the others. The network, which will cover about 4,000 miles with 44 transmitters and 80 radio relay stations, will include British equipment to the value of nearly £2 million. Every country will be using British equipment.

The diagram shows the links which will make possible the eight-nation exchange of TV programmes from June 6 to July 4. The link between Italy and Switzerland includes a British-equipped radio relay station 15,000 feet up on the Jungfrau.



NON-LINEAR RESISTORS

(By the Engineering Department Aerovox Corporation)

(Continued from April Issue)

THERMISTORS

The thermistor, a product of research by Bell Telephone Laboratories and manufactured by Western Electric Company, is another interesting non-linear resistance device. Its action results from internal heating effects in special materials.

Thermistors basically are thermally-sensitive resistance devices. They are manufactured in the shape of rods, discs, beads, wafers, and flakes are made of various semiconductor materials. Like thyrite, the thermistor can be used with either A.C. or D.C.

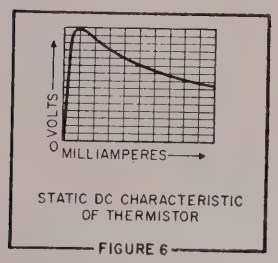


FIGURE 6

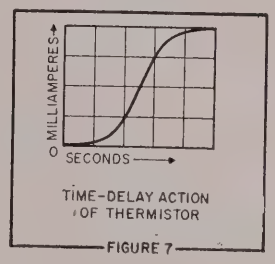
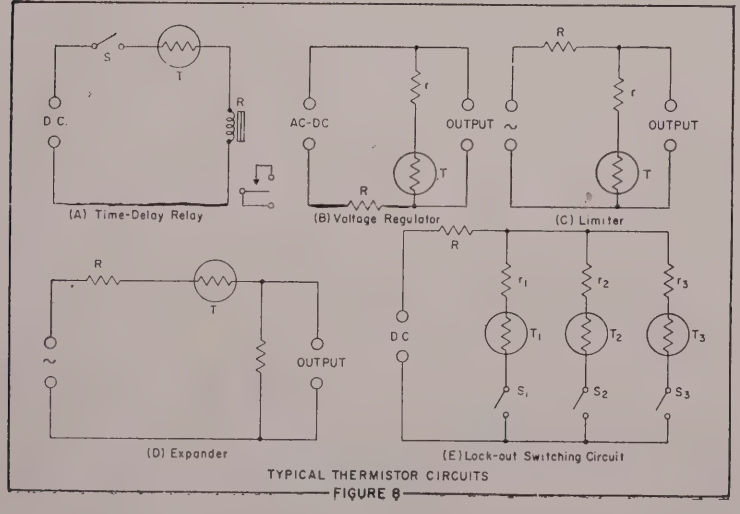


FIGURE 7

Figures 6 and 7 show two important response curves describing thermistor action. From Fig. 6, it is seen that the voltage drop across the thermistor increases non-linearly and rapidly with current flow up to a point beyond which the rate of increase falls. Finally, a peak is reached and beyond this latter point, the voltage drop decreases with increasing current, displaying negative resistance. An interesting side observation is that this negative-resistance property has been utilized to obtain low-frequency tubeless oscillation and amplification with thermistors.

In Fig 7, the plot shows how at a particular applied voltage internal heating causes the magnitude of thermistor current to vary as a function of time. This property has been utilized in various simple time-delay devices.



TYPICAL THERMISTOR CIRCUITS

FIGURE 8

Figure 8 shows several simple circuits employing thermistors. In all except Fig. 8(A), a small current-limiting resistor, r, is indicated. Fig. 8(A) is a time-delay D.C. relay based upon the action illustrated by the curve in Fig. 7. Some seconds after the switch, S, is closed, the circuit current rises to a value high enough to close the relay. The delay interval depends upon thermistor characteristics and supply voltage level, and can be adjusted to some extent by means of linear series resistance.

Figure 8(B) is the circuit of a regulator for supply-voltage variations and is somewhat similar to the thyrite voltage regulator. Its operation is based upon the non-linearity of the thermistor which results in smaller variations in thermistor voltage drop than the fluctuations occurring in supply voltage and current.

Action of the limiter circuit, shown in Fig. 8(C), is similar to that of the voltage regulator, amplitude excursions in the input signal being reduced in the output without clipping or slicing action.

Operation of the thermistor expander circuit, Fig. 8(D), is the opposite of that of the limiter. The thermistor and load resistor are interchanged in position, output being taken across the resistor. A small signal-voltage change produces a large thermistor current change and a large voltage change across the output resistor.

A voltage division takes place in the circuits shown in Fig. 8(B), (C), and (D), as the result of potentiometer action between the thermistor and the linear series resistor. Because of this action, the absolute level of the applied voltage is reduced in the output.

Figure 8(E) shows a lockout-type switching circuit employing thermistors. In each leg of the circuit, r is a load resistor or represents some device, such as a relay, which is to be actuated by current flowing through the associated thermistor. The supply voltage and the value of linear series resistor R are chosen such that this resistor will support the current of only one leg before its voltage drop becomes excessive. When one switch (say, S_1) is closed, the associated thermistor "break down" allowing current to flow through and operate the associated device, r_1. This lowers the voltage at the inside of R, so that no other thermistor can "fire." Only after S_1 is opened, can either of the other circuit legs be operated. Operation of any one thermistor leg thus locks out all the other legs. An arrangement of this type would enable a number of devices having similar volt-ampere characteristics to be connected across a single voltage pair, but with only one device operable at a time.

FILAMENTARY DEVICES

The tungsten-filament incandescent lamp is fairly well known as a non-linear resistor in which current change lags a corresponding change in applied voltage. Up to the point at which heating effects begin to evidence, the filament volt ampere characteristic its linear, or very nearly so. The non-linear region of

(Continued on page 31)

The PHILIPS Experimenter

No. 80: A Transmitter for the Beginning Amateur

INTRODUCTION

A short time ago, those of us responsible for preparing and presenting these articles, realized with somewhat of a shock that the Philips Experimenter has been running for nigh on seven years! In that time we have dealt with a wide variety of topics, most of them backed up by the preparation of up-to-date designs for amateur equipment. It seemed to be time we re-traced our steps, back past single sideband, hundred-watt transmitters, etcetera, to the point where we could describe some gear designed specially to suit the needs of the ever-growing body of newer amateurs. Accordingly, we have designed a complete 80-metre station for both 'phone and C.W., which will be described in this and succeeding Experimenter articles.

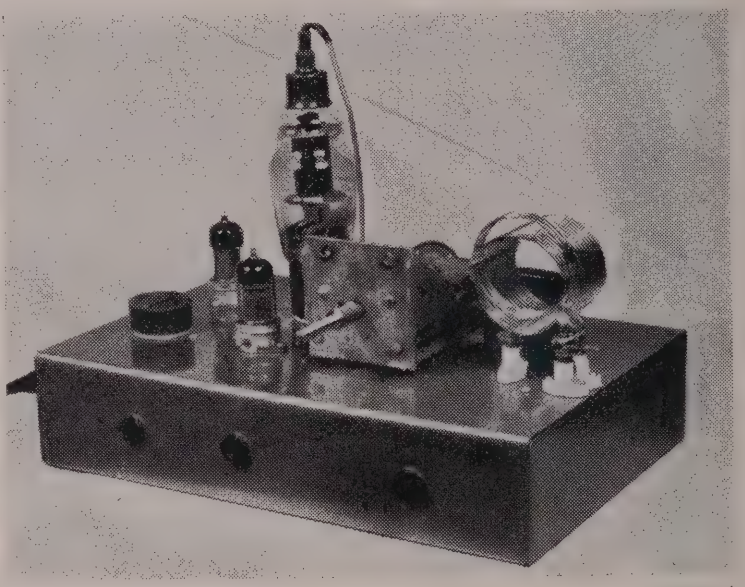
At the same time, we hope that the old hand will not be put off by the fact that they are addressed specifically to newcomers to the "ham" game. The transmitter which forms the subject of our first instalment is not representative of that class of amateur equipment which is over-simplified, in the mistaken belief that anything for the beginner must of necessity have as few parts as possible. The main theme in its development was the need of the beginner for something which is straightforward in construction and operation, and which above all, does not require an experienced hand to obtain results from it. We have for some time held a theory that many amateur designs, of disarming apparent simplicity have not really been suitable for those who are just setting out to discover for themselves the mysteries of radio design and construction, and it is hoped that these articles will not only provide the basis of pleasurable achievement for numerous owners of new call-signs, but will also find not a few "buyers" among old-timers who want something quick, simple, and effective in the way of stand-by equipment.

DESIGN CONSIDERATIONS

The first and most important of these has already been mentioned in the last paragraph, but a transmitter can take on so many forms and aspects that one might be forgiven for being in something of a quandary as to just what sort of specification is called for. However, after considerable thought the following list was drawn up. We do not claim that ours is the only possible approach, but we do think it is a logical one, and one which should introduce the newcomer to his hobby in the pleasantest and most efficient manner.

(1) Crystal Control

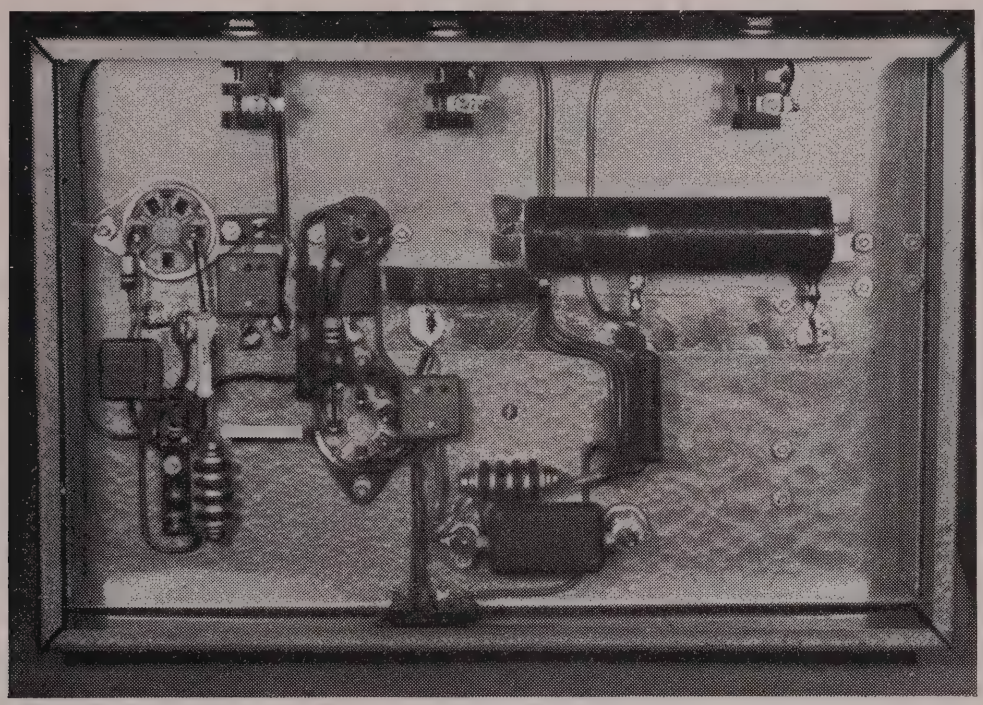
Whatever the disadvantages these days of being "rock-bound," or in plainer terms, tied firmly to one transmitting frequency (unless one becomes the possessor of a flock of different crystals) the advantages of crystal control are too strong to be ignored. Some beginners might certainly be able to make a good fist of a V.F.O. transmitter, but in our opinion at least, this should be kept until one has gained some experience. The beginner has enough to worry about without having the constructional difficulties of the V.F.O. forced upon him. And we are sure that old-timers will agree that a crystal-controlled apprenticeship is almost essential in teaching the newcomer the rudiments of good operating! Then, too, the crystal-controlled transmitter relieves one at the outset of much of the frequency-measuring responsibility thrust upon one by a V.F.O., allowing one to concentrate on other more immediately interesting matters. Accordingly, the transmitter starts off with a simple but effective crystal oscillator circuit, using a Philips EL42.



The finished transmitter. The left-hand jack is the grid current one, with the keying and plate current jacks to the right, in that order. The tube behind the crystal is the oscillator, and the one in front of the QE06/50 is the screen-grid protection tube.

(2) Power Output

While it is not suggested that the full 100 watts input is needed if one is to obtain worth-while results, we do feel that a reasonable power output is very helpful. Extremely low-powered transmitters may be cheap to build, but they are really a specialist's job, and this transmitter should prove that forty watts input need not be an



expensive proposition, and at the same time gives more than enough power output for permanent use, should the new amateur decide that his interests are directed more towards operating than to building new gear.

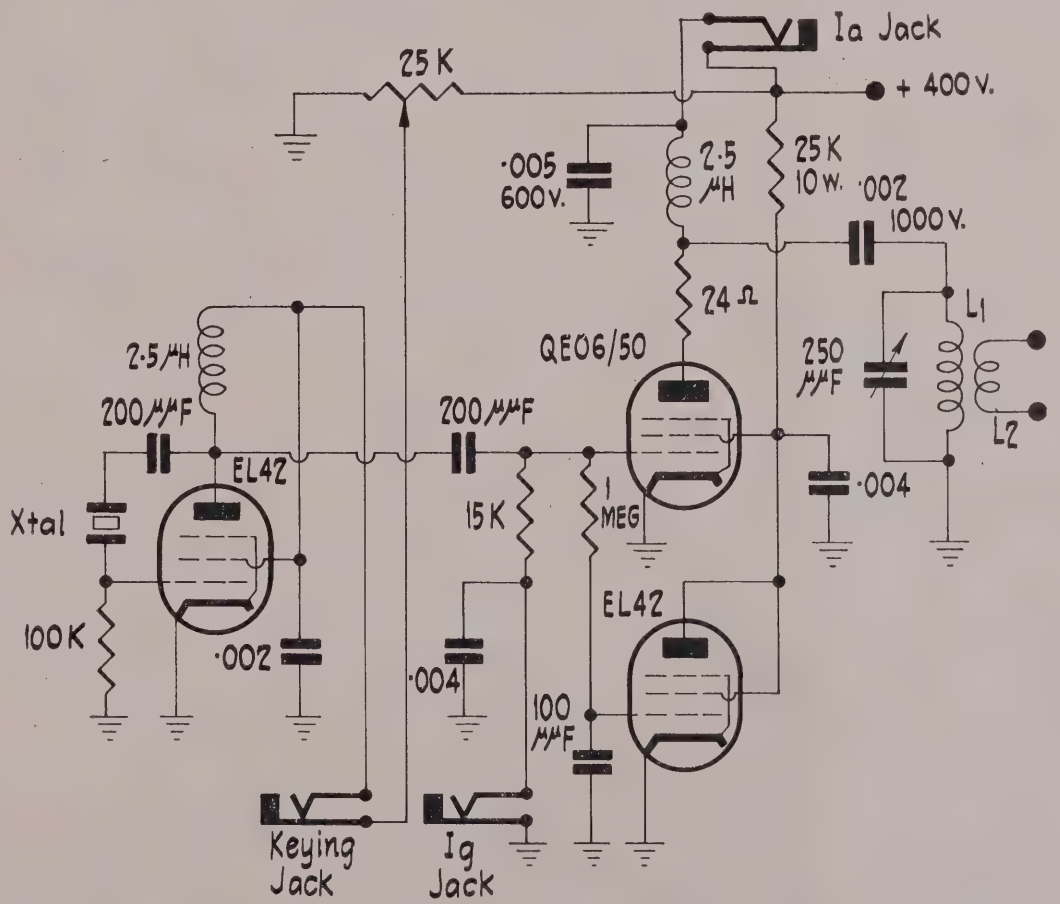
Although the transmitter uses only two stages, it can take up to 75 watts input, and can turn out up to 47 watts of R.F. Initially, however, we are recommending a 400-volt power supply, which will allow an input of 40 watts, and an output of 25 watts on C.W. The circuits have been designed for this H.T. voltage.

(3) Valve Line-up

Although triodes are still used in transmitting circuits, pentodes or beam-tubes have become almost standard practice for low-powered stages, and it was felt that to choose a triode, while it might provide good experience, would not be in conformity with the most modern practice. For the power level decided upon, it is almost impossible to go past the Philips QE06/50. This is electrically identical with the very popular 807, so that its type number will be the only thing about it at all unfamiliar. Not only is it an excellent valve in its own right, but now that the flood of war-surplus 807s has ceased, amateurs will find the QE06/50 competing not only in performance but in price too, with its perhaps better-known equivalent. It has the advantage that it is very unlikely to become obsolete, as seems to be the fate of many transmitting tubes; it will always fit into the design of a more advanced transmitter, and so need never gather dust on the shelf.

The EL42 is not a transmitting tube at all, being a small, but very efficient audio output valve, with excellent properties as an R.F. tube also. It was chosen for the oscillator for two reasons. First, it is large enough to deliver ample driving power for the final amplifier, and yet is small enough to be economical in H.T. power. Secondly, it makes an excellent frequency multiplier, and like the final, can also find a place in subsequent constructional efforts without having to be discarded.

The third valve does not really enter into the line-up of the transmitter at all, as it is there is an important, but secondary role. Its job is to prevent the final amplifier from damage when the oscillator is turned of, both during keying, for CW use, and in the event of failure of the oscillator for any reason, during phone operation. A variety of types could have been used here, but the EL42 was chosen again in the interests of uniformity.

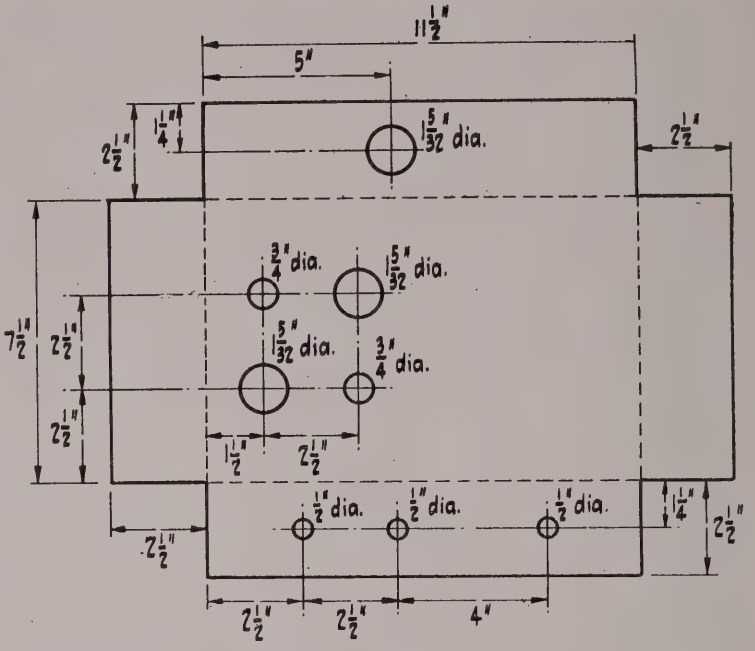


(4) Circuit Arrangement

The first thing to be noted about the circuit is that apart from the crystal, only one tuned circuit is used, namely the plate tank of the final amplifier. This is made possible by the choice of a Pierce crystal oscillator circuit, and is one of the most important features. Other oscillator arrangements contain circuits tuned to the trans-

mitter frequency in their plate leads, and if any of them had been used, it would have meant making a much more complex mechanical job in order to achieve the same stability of operation that is obtained with the present arrangement, without recourse to shield partitions and the like. For a beginner in the ways of transmitters, nothing can be more frustrating or conducive of alarm and despondency than a final amplifier that will insist on oscillating of its own accord. Frequently, a poorly designed transmitter will do just this, and will be guilty of off-band transmissions and nasty ragged signals as a result, while the unfortunate owner is often not even aware that such things can occur! Oscillation of the final amplifier is rendered very unlikely indeed by the simple expedient of not having a tuned circuit either in its grid, or in the plate of the preceding valve. The behaviour of the prototype has more than justified this statement, having proved itself the most tractable thing of its kind that we have had the good fortune to meet.

But since we are addressing ourselves chiefly to beginners, we should make it clear that in transmitters, as in everything else, it is not the *circuit* that is stable. It is the transmitter, as built. The circuit is nothing more than a few scratches on paper, and we are not in the least guilty of facetiousness when we say that as such, it can't possibly be unstable. The mechanical construction and layout is every bit as important, if not more so, than the circuit diagram. It is surprising how many people will go to ridiculous lengths to obtain components exactly as specified in a parts list, and then spoil the whole thing by making indefensible changes in the equally well-thought-out mechanical design. Even those who should know better, do this and then blame the designer of the "circuit" if things do not function properly. This little pep-talk is not meant for sermonizing. It is to impress upon those who may be building their first



transmitter that if they are to be sure of duplicating the results obtained with the original model, they must be prepared to build it as much like the original as possible. If they do not, they may be lucky, but on the other hand they may not, and might easily buy themselves a parcel of trouble. We don't pretend that our arrangement of the parts is the only satisfactory one, or even the best, but it is one which has been found to work in a trouble-free manner.

(To be continued)

Letter to the Editor

Sir.—I should like to assure Mr. Stagpoole that I never suggested that a miniature condenser microphone was not a better microphone for some purposes than the ribbon microphone. Not having access to the article by Cook on noise testing, I cannot determine the reason for the different results obtained by Olson and by Cook when testing the transient response of microphones, although I suspect that the differences arise from the different directional properties of the microphones.

It has long been recognized that ribbon bi-directional microphones tended to give rather woolly results when used for orchestral recording, due to their being placed a considerable distance from the orchestra and thereby receiving sound much modified by reverberation. Good moving-coil microphones tended to give better results, due to their being almost non-directional, and were therefore able to be used much closer to the orchestra. With the improvement in recording studios, the need for directional microphones has become less. The modern miniature condenser microphone duplicates the directional pattern of the moving-coil microphone, but has a better frequency response. It has replaced the ribbon bi-directional microphone mainly because of its non-directional response and not because of any superiority in transient response.

Transient testing is usually done with square waves because it gives a waveform that is easily recognizable on an oscilloscope, and deviations therefrom are easily seen. It is surely quibbling to say that square waves are not a series of transients. However, to be exact, it is possible to use a step function, a single uni-directional pulse, which is also easily recognizable. The response on any linear electrical, electromechanical, or purely mechanical system to such a step function can be deduced from the frequency response alone. In general, it can be said that a system with a wide smooth frequency response has a good transient response, while resonant peaks or dips or a sharp cut-off or a restricted frequency response cause a deterioration in transient response. A resonant frequency that is so well damped that it does not produce a dip or a peak on the frequency response curve does not affect the transient response. This is the case with the low resonant frequency of the ribbon microphone.

The analogy of the moving-coil loudspeaker still seems to me to be valid. Although ordinary loudspeakers exhibit cone "break-up," good speakers have stiff cones and soft resistive surrounds that minimize this fault. These speakers have very low cone resonances, an almost total absence of other resonances, and a good transient response.

I am well aware that low-frequency distortion in amplifiers and speakers can produce an apparent increase in bass, but to one pair of ears, at least, the low-frequency distortion produced by pick-ups seems to have the opposite effect. Any distortion produces hamonics, which, being higher in frequency, will receive less bass boost (referring to magnetic pick-ups, of course), so that the overall output tends to be less, although this is offset by the increased sensitivity of hearing at higher frequencies. In an amplifier, the harmonics are not subject to the relative reduction occurring in the bass boost circuit and so tend to sound louder. I do think, however, that the hash produced by the resultant intermodulation distortion masks the low-frequency sounds.

If Mr. Stagpoole was merely trying to establish that records do vary in quality, then I must agree with him. However, it is only fair to point out that the overall quality of modern recordings is much better than we have had in the past. It is significant that the record reviewers of your contemporary, the "Gramophone," rarely condemn a record pressed in England as being unsatisfactory technically. Records from other sources may not be as satisfactory.

Not having seen the original papers on the R-J Enclosure. I cannot be dogmatic about it. But it is usually found that small vented baffles are not very satisfactory, due to the difficulty of damping the internal resonances and because the volume of air behind the cone is not sufficient to load it properly. In these circumstances, it is usually better to use a totally enclosed box, the so-called infinite baffle. I cannot see that the R-J Enclosure overcomes these limitations. The R-J Enclosure, as far as I know, has not been received with much favour by audio engineers, and until more complete data are available it would seem wiser to adopt the well-tried principle of the vented baffle. I am glad to see that your editorial in the February issues shares my distrust of new ideas until they have been well proven.

I have hoped that someone with more practical and theoretical knowledge than I would enter this argument and present a more authoritative opinion than I am able to give.—I am, etc.,

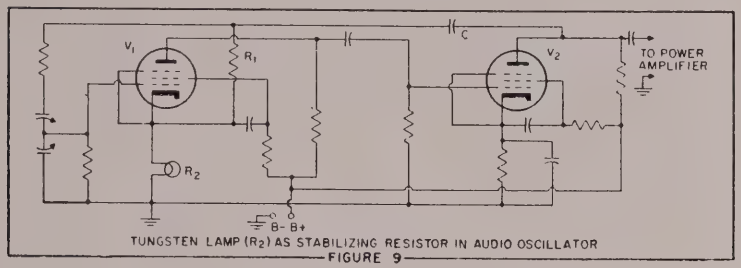
M. S. PATTINSON.

Non-Linear Resistors

(Continued from page 27)

lamp-filament resistance has been utilized in voltage stabilization bridges, simple regulators, and allied devices.

In a common application, the lamp-type resistor



TUNGSTEN LAMP (R_2) AS STABILIZING RESISTOR IN AUDIO OSCILLATOR

FIGURE 9

is used as an automatic regulator of degeneration voltage in low-distorting, RC tuned oscillators. A typical circuit is shown in Fig 9.

In Fig. 9, the lamp (R_2) is the cathode resistor of the first pentode, V_1. Feedback current from the output of V_2 flows through capacitor C to the frequency-selective RC network in the grid circuit of V_1. A portion of this current also flows through resistor R_1 of the lamp R_2, establishing a negative feedback voltage across the latter. The lamp resistance is low when the feedback current is small, and is high when this current is large. Thus; strong oscillations result in large amount of inverse feedback voltage across R_2, and this degeneration in turn reduces the amplitude. The operation also is true; at weak oscillation amplitudes, there are lesser amounts of degeneration, and gain though the two-tube circuit automatically rises. The net result is uniform amplitude of oscillation.

Thermistors also are used occasionally in some RC-tuned oscillator circuits to stabilize oscillation amplitude.

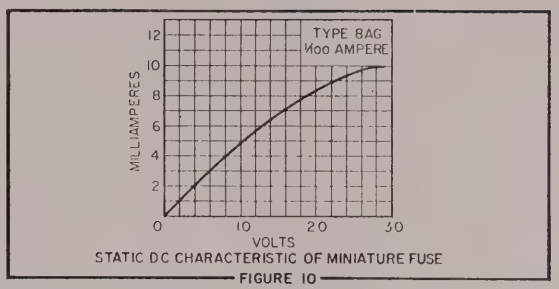
Small filamentary low-current fuses exhibit a type of non-linearity somewhat similar to that of the tungsten filament. Fig. 10 shows the static D.C. volt-ampere characteristic of a sample type 2AG 10-milliampere littlefuse. In this instance, response is linear from zero up to the 0.8v., 4 ma. point. Beyond this, the non-linearity is apparent.

When D.C. is based to a point within the square-law region of their non-linearity, such fuses often are used as bolometer-type detectors in micro-wave work. This provides an extremely simple and inexpensive demodulator at frequencies up to many hundreds of megacycles.

DIODE-TYPE RESISTOR

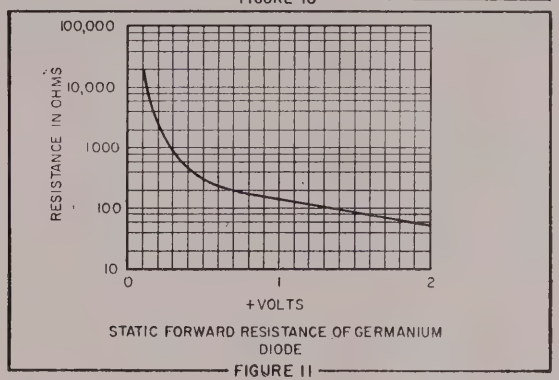
Non-linearity in the forward conduction characteristic of the germanium diode suits this simple component to use as a non-linear resistor in applications within its current capabilities. While the reverse-conduction (back-current) characteristic of the diode also is non-linear, it does not in general offer the same possibilities of application that are available with the front conduction.

Figure 11 shows a plot of forward resistance-applied voltage for a high-conduction-type germanium diode. Here the polarity of the applied voltage is such that the anode of the diode is positive. Diodes may be connected in series, parallel, series-parallel,



STATIC DC CHARACTERISTIC OF MINIATURE FUSE

FIGURE 10



STATIC FORWARD RESISTANCE OF GERMANIUM DIODE

FIGURE 11

and parallel-series to obtain many attractive non-linear resistance effects.

Various portions of the forward volt-ampere characteristic of the germanium diode exhibit square law, logarithmic, and finally approximately linear relationships between E and I. By operating the diode in a desired one of these regions, the particular corresponding portion of the curve can be utilized to correct or modify the E/I characteristic of another circuit. For example, a linear microammeter may be converted into a square-law instrument by using the forward resistance of the diode at the meter series resistance (multiplier).

Diodes suffer somewhat in comparison with other 2-terminal non-linear resistors because the diode is a rectifier. This limits application in some cases to direct-current use only. However, small A.C. signals may be superimposed upon a D.C. forward bias current applied to the diode, the two currents being so proportioned that the net diode voltage never becomes zero or negative. Diodes also are relatively low current devices, as compared with some other non-linear resistors.

Like the thyrite resistor, the forward-conducting diode is capable of distorting an A.C. current wave-form and occasionally is used to accentuate harmonics. The requirement is that the diode current magnitude be such as to operate the diode in its most non-linear region. Thus, the simple series connection of a diode in the plate or grid lead of an oscillator or amplifier can accentuate harmonic content of the current wave-form when this type of operation is required. An example, is the distortion of wave-form of a standard frequency oscillator to produce high order harmonics for calibration purposes.

TUBE DATA: Receiving Valve 6BR7

(Information by Courtesy of Brimar)

INTRODUCTION

The Brimar 6BR7 is a single-ended indirectly heated screened pentode of miniature construction intended for use where low A.F. noise, microphony and hum are required, as in early stages of high-gain A.F. amplifiers. The heater is intended for operation in parallel with those of other valves in A.C. operated equipment.

Very effective internal screening is employed, but the input and output capacitances are low enough to allow the valve to be used in R.F. applications up to frequencies of at least 20 mc/sec.

In this report are characteristic curves and details of the performance of the valve as a resistance-capacity coupled amplifier. The anticipated levels of hum, hiss, and microphony are given, and the precautions necessary to ensure the best performance are discussed.

DESCRIPTION

The valve is a miniature screened pentode with characteristics similar in most ways to those of the 6J7 valve. The structure is mounted in a T6½ bulb and is fitted with a B9A (Noval) base. The whole assembly is designed with a view to obtaining the utmost possible rigidity. The control grid is screened internally from the heater to eliminate hum due to electrostatic pick-up from that source. The heater is wound in the form of a double spiral to reduce, as far as possible, the magnetic field set up by the heater current.

CHARACTERISTICS

Cathode

Indirectly heated

Voltage	6.3 volts
Current (nominal)	0.15 ampere
Max. D.C. heater-cathode potential	100 volts

Dimensions

Max. overall length	2 3/16 in.
Max. diameter	⅞ in.
Max. seated height	1 15/16 in.

Base: Type B9A (Noval)

Pin 1: No connection
Pin 2: Control grid
Pin 3: Cathode
Pin 4: Heater
Pin 5: Heater
Pin 6: Internal shield
Pin 7: Plate
Pin 8: Screen grid
Pin 9: Suppressor grid

Ratings (Design Centre)

Pentode connected:

Max. plate voltage	300 volts
Max. screen voltage	125 volts
Max. plate dissipation	0.75 watts
Max. screen dissipation	0.3 watts

Triode connected:

(g2 connected to plate, g3 connected to cathode)

Max. plate voltage	250 volts
Max. plate dissipation	1.75 watts

Inter-electrode Capacitances

(measured with no external shield)

Pentode connected:

Input	4.25 pF
Output	4.0 pF
Grid-plate	0.01 pF max.

Triode connected:

Input	3.2 pF
Output	6.7 pF
Grid-plate	1.1 pF

Characteristic Curves

Curves are included in this report which show:

Plate current versus plate voltage (I_p/E_p) at various values of control grid voltage with a screen voltage (E_{g2}) of 125 volts, No. 308.215.

Plate current versus control grid voltage at various values of screen grid voltage, No. 308.220.

Plate current versus plate voltage with the valve connected as a triode, No. 308.219.

Mutual conductance and impedance versus control grid voltage for the valve connected as a pentode, No. 308.221.

Mutual conductance, impedance, and amplification factor versus grid voltage for the valve connected as a triode, No. 308.222.

Typical Operation

Pentode connected (g_3 connected to cathode):

Heater voltage	6.3	6.3	volts
Plate voltage	100	250	volts
Screen voltage	100	100	volts
Grid voltage	—3	—3	volts
Cathode bias resistor	1100	1100	ohms
Plate current	2.0	2.1	mA
Screen current	0.7	0.6	mA
Plate impedance	1.5	2.4	MΩ
Mutual conductance	1.1	1.25	mA/V
Inner amplification factor	20	20	
Grid voltage for 1/100 g_m at $E_{g1} = -3$	—8	—9	volts

Triode connected

(g_2 connected to plate, g_3 connected to cathode)

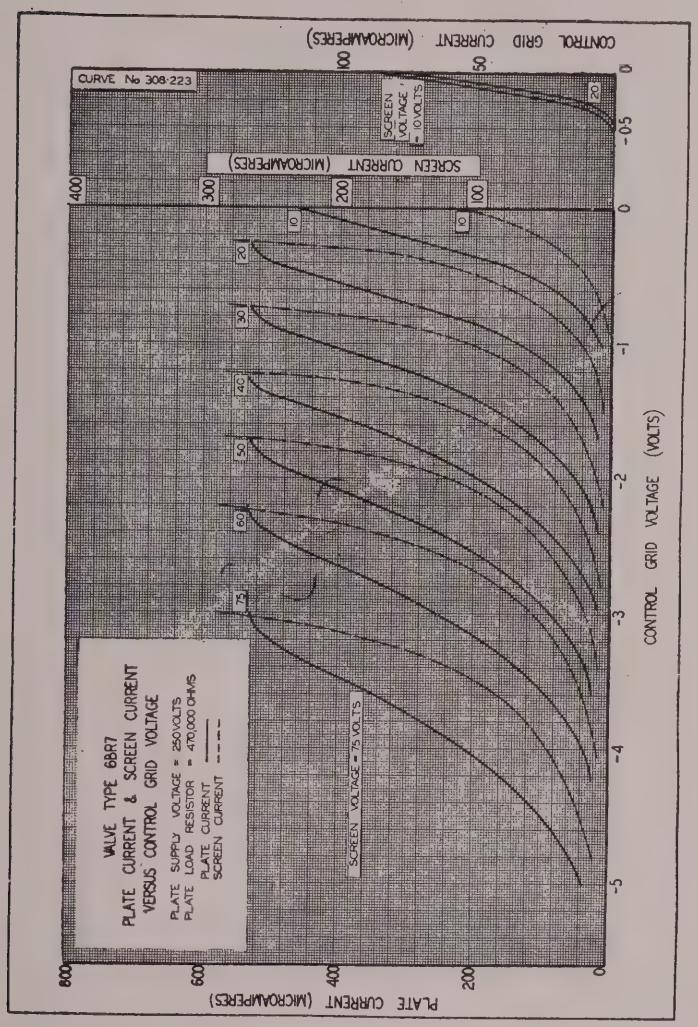
Heater voltage	6.3	volts
Plate voltage	250	volts
Grid voltage	—8	volts
Plate current	6.5	mA
Mutual conductance	1.72	mA/V
Plate impedance	11,600	ohms
Amplification factor	20	

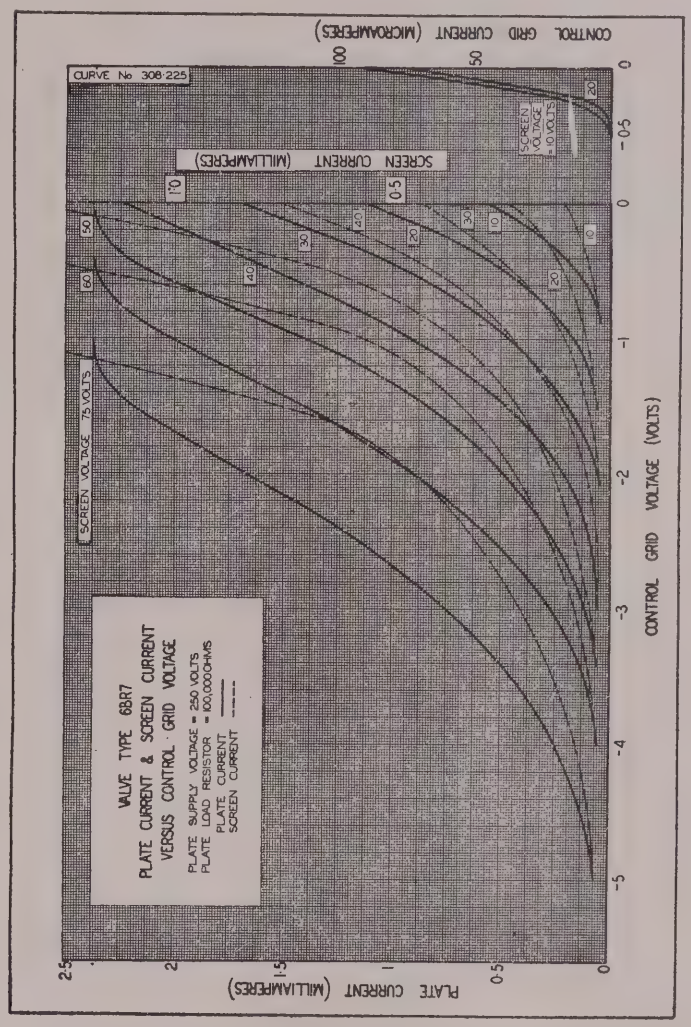
Operation as a Resistance Capacity-coupled A.F. Amplifier

Pentode connected:

In the table below are given typical operating conditions under various conditions of plate load and supply voltage which yield an output with approximately 5 per cent. distortion.

Plate supply voltage			100				300		volts
Plate load resistor	100	220	470	100	220	470	kΩ
Cathode bias resistor	1.3	3.3	5.6	0.56	1.5	2.2	kΩ
Series screen resistor	0.47	1.5	2.8	0.47	1.5	2.8	MΩ
Succeeding stage grid resistor ..	1.0	1.0	1.0	1.0	1.0	1.0	MΩ
Peak output voltage	21	28	31	70	92	100	volts
Voltage gain	65	80	140	104	124	185	volts





Included in this report are curves of plate and screen current versus control grid voltage taken with a supply voltage of 250 volts and various values of plate load resistor. The characteristics for a plate load of 100 kΩ are given on No. 308.225, and for 470 kΩ on No. 308.223. The method of using these curves for calculating the resistance-capacity coupled amplifier performance is as follows:—

As an example, assume it is desired to operate with a load resistor of 220 kΩ and a succeeding valve grid leak of 1 mΩ. It can be seen from the curve that control grid current sets in at about —0.5 volts, so that the bias should be chosen to prevent excursion into voltages lower than this. If a value of —2.0 volts is selected, a reasonably linear I_p/E_{g1} characteristic is obtained with the screen grid operating at 50 volts. With such an operating point, the plate current is 0.48 mA. and the screen current 0.23 mA. The cathode bias resistor will be

$$\frac{0.48 + 0.23}{2.0 \times 1000}$$

or 2800 ohms. The series screen resistor will be

$$\frac{200 \times 1000}{0.23} \text{ or}$$

0.87 MΩ.

Allowing a peak input voltage of 0.3 volt, the grid will swing from —2.3 to —1.7 volts, giving a plate current swing of 0.32 mA to 0.68 mA or 0.36 mA peak to peak. In a 220 kΩ load, this corresponds to an output voltage of 79 volts peak to peak or 39.5 volts peak. The voltage gain is then 131 times.

As allowance must be made for the following grid leak of 1 MΩ, these figures must be reduced by a factor of

$$\frac{10^6}{10^6 + 0.22 \times 10^6} \text{ or } 0.82$$

The stage gain is then 108 times and the output voltage 32.5 volts peak.

The distortion may be estimated by inspection of the relative stage gains at the positive and negative peaks of the signal. The gain at —2.3 volts is

$$\frac{(0.48 - 0.32) \times 220 \times 0.82}{0.3}$$

or 96.5 times.
The gain at —1.7 volts is

$$\frac{(0.68 - 0.48) \times 220 \times 0.82}{0.3}$$

or 120 times.

The distortion is then

$$\frac{120 \left(\frac{120 + 96.5}{2}\right)}{120 + 96.5} \times 100 = 5.3\%$$

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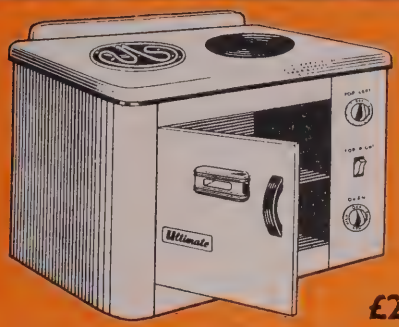

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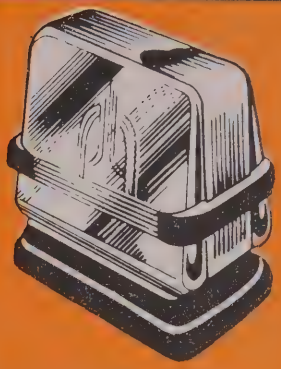

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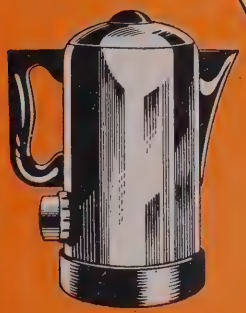

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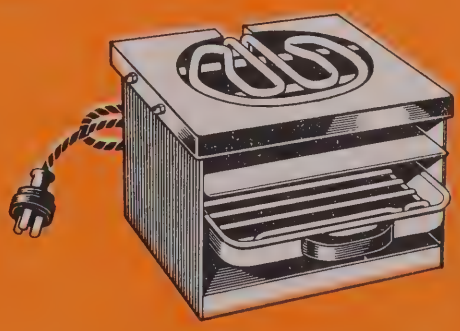

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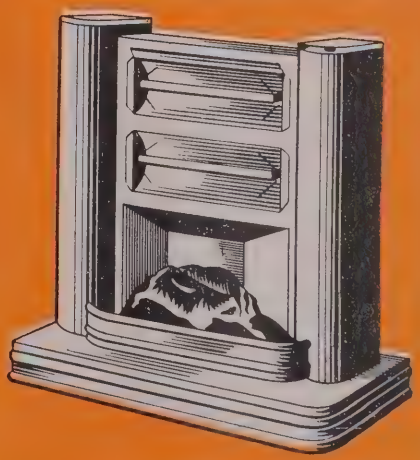

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LIGHTING THE HIGHWAYS

(Information and photographs for this article were supplied by Messrs. Philips Electrical Industries of N.Z. Ltd.)

The lighting of roads and streets, etc., is just one of those problems with which the lighting expert still has to grapple. Public lighting, as the lighting of streets, public squares, and byways is called, is not a formula that can be applied everywhere; safety is the only major consideration on roads outside the residential centres, whereas within the built-up areas other considerations apply in addition to safety, as, for instance, the tone of a street, the general appearance and character of the town, and so on.

In this article, however, we are concerned only with the lighting of highways for fast traffic. At night time, good lighting and safe speeding go together.

The annual expenditure for damage resulting from traffic accidents is staggering. A small percentage of this expenditure would suffice to cover the annual working costs of hundreds of miles of highway lighting. It is not a question of whether we can afford the luxury of good highway lighting, but rather a question of whether it is economically admissible to have our highways only part lit or not even lit at all. Quite apart from the greater degree of safety on the roads provided by good lighting, it also means, especially for freight traffic, an enormous saving in time. This is certainly the case in bad weather. Time saved is also money saved, and it might be very interesting one day to calculate the actual saving represented.

TO SEE AND BE SEEN

It is important for the user of the highways, at whatever time of day or night it may be, that he can clearly see where he is and what obstacles await him. No less important is that he himself can be seen, and he must know that he is seen so that he can drive with his mind at ease.

On the great majority of highways, the motorist is still entirely dependent upon the light thrown by his headlamps over long stretches of road. This would certainly be sufficient if the driver were alone on the highway. In busy two-way traffic, however, the light from headlamps represents a danger for oncoming vehicles. In order to pass each other, both oncoming vehicles must dip their lights at some considerable distance beforehand, and, from that moment on, the view of the unlighted road is inadequate, especially as even dimmed lights may blind the oncomer. The critical moment comes—and every motorist and motor-cyclist knows this from experience—when actually passing, because at that moment it is impossible to see anything that lies or moves ahead. Reasonable and steady speed and a feeling of safety are out of the question without good highway lighting, and that is why driving by night on unlit roads is and remains both tiring and perilous.

Our eyes are extremely sensitive instruments that react swiftly to any change in the intensity of light. Continually having to accommodate the eyes to changing intensities is, in the long run, excessively fatiguing, and tired drivers are a danger to themselves and to others. The busier the highway, the more noticeable is the inconvenience caused by the lack of good lighting.

GLARE: THE GREAT PERIL ON THE HIGHWAYS

As a type of highway lighting, the light from headlamps, apart from the nuisance of blinding oncoming traffic, has also the tendency to make a "vertical" object on the highway brighter than its background, while a "vertical" background (trees, house fronts, fencing, etc.) becomes lighter, against which the object stands out less distinctly. Highway lighting with appropriately shaded sources of light is, on the other hand, free from inconvenient glare and has the tendency to brighten the background while leaving the objects dark. This is the natural state to which we are accustomed during the daytime.

When, while driving along an unlighted highway, the driver encounters here and there at the approach

B 16222.—Sections of a roundabout where a total of 78 sodium lamps have been installed on lamp standards 9 m. high.

—Photo Philips.

of villages a lamp-post with an unshaded bulb, often, to make matters worse, reflected on the road in rainy weather, he is placed under an abnormal strain and his perception of the road is unduly obstructed. If there are complaints, the lamp is often replaced by a stronger one which only aggravates the situation. With such scanty "highway lighting," however, one must value the good intention rather than the useful result. In fact, it is only possible on such a highway to see other road users and the course of the road itself—bends, crossings, and narrow sections—when they are actually within the shaft of light thrown by the headlamps. But everything that lies beyond a dazzling street-lamp is shut off as though by a black wall.

The condition of the road surface and the material of which it is made also play a very important role. Lighting is reflected to a high degree by wet roads, especially by asphalt surfaces. Least trouble is found on cemented, cobbled, and clinker surfaces. Although these, too, reflect when dry, they do so to a much lesser degree than when wet. The reflection appears in the familiar bright streaks of light running towards the driver on the road surface. When these streaks of light become too pronounced, the regions of the road lying in between become relatively so dark that nothing more can be perceived. This is known as secondary glare, to distinguish it from the primary glare from headlamps or similar sources of light. As

this reflection effect increases in proportion to the amount of primary glare, the primary glare must be suppressed by shading the lamps. It is also possible to choose a particular colour of light which even in the long run does not trouble the eyes.

SODIUM LIGHTING: EFFICIENT AND PLEASANT

Every motorist who, after driving for a long time on unlit or badly lit roads, suddenly enters upon a stretch of road lit by sodium lamps, feels an unmistakable sense of relief and freedom. Every user of the roads can test this on himself. How can this be explained?

In contrast to sunlight or incandescent lamp-light (which are made up of the spectrum colours), the sodium lamp gives off a monochromatic light, about 96 per cent. of which is orange-yellow. At first sight,

B 16217.—A main highway in the vicinity of a large town, lit by sodium lamps SO 85.
—Photo Philips.

this colour might appear to be a disadvantage. However flattering candlelight may be (which light as a colour is something like that of the sodium lamp), it cannot be denied that the effect of sodium light on the human appearance is wretched. But what does the driver in fast traffic care about the colour of his fellow road-user's complexion or clothes? As long as they can see each other clearly and in time, as long as they can command a comprehensive view of the highway and of their immediate surroundings, and as long as the nerve-wracking fussing with headlamps and dippers can be done away with, then, for all they care, the green trees can be brown and the blonde on the bicycle without a rear light might as well have bright green hair.

Those of us who do not judge lighting for fast traffic by the colour of a scarf or a pair of gloves, are struck by four outstanding characteristics of well-executed sodium lighting—namely:

(1) The "tranquillity" of the general scene;

(2) The great distance at which an object on the road can be picked out and recognized (visual acuteness);

(3) The distinctness with which the object seen stands out against its background (good brightness contrast);

(4) The relatively slight influence of rain and mist on visibility.

NO IRRITATION EFFECT

The motorist's attention is fixed continuously on the highway. Nearly every action necessary for steering follows automatically from what the driver sees in the ever-changing scene before him. In this teamwork of senses—brain, nerves, and muscles—it is the brain that plays the part of central importance, where, as a result of impressions received, a plan is worked out which is conveyed to the muscles via the motory nerves. This is no simple process, and for the sake of safety on the roads, it must take place with speed and unerring precision. If the working of the brain is disturbed, the reactions are less precise and perhaps also slower. The public roads at night are full of irritating factors. One of the worst of these is the nuisance caused by headlamps from other cars, badly designed lighted advertisements, and the unshaded lamps of an imperfect public lighting system. The nuisance reduces the perceptive ability, and a feeling of insecurity arises, an unconscious fear that something essential might escape our attention. In the result, the brain works less certainly, and the chance of incorrect or delayed reactions is increased.

NO WHITE LIGHT ON THE HIGHWAYS

Well-executed sodium lighting is free from irritation effect. In the first place, the colour of the light has something tranquil and comfortable about it. We have a marked preference at low lighting intensities for "warm" coloured lighting, whereas we feel that white light has something uncomfortable about it and not appropriate to the circumstances. White light is all very well and good if supplied in generous doses, but, of course, for reasons of economy, this is just not possible on the highways.

The scene illuminated by sodium lighting is sharp and distinct and gives a feeling of security.

Another factor in sodium lighting, and this is very important for the overall impression, is that exposed parts of reflectors, side lights on a car, reflection from the road surfaces, and even visible sodium lamps are not felt or are hardly felt to be troublesome. It is even quite possible to proceed on one's way immediately after having looked straight into a sodium lamp. There is scarcely any after-image on the retina, and visual perception does not noticeably suffer from the glare it has just been subjected to. An indication that the eye is not adversely affected by high intensities of sodium light is that the pupil remains wide open. This should not be taken to mean, however, that shading of the lamps may be neglected. Simultaneous glare, no matter how mild, lowers visual performance.

The motorist who enters an area of road illuminated by sodium lamps is received into an environment where he is put at his ease, and this increases his ability to react correctly to visual stimuli. Alas, there are still too many road users who, out of short-sightedness, lack of understanding, or stupid indifference, continue to leave their headlamps blazing when sidelights or parking lights would be quite sufficient, thus completely nullifying the advantage of good highway lighting for oncoming traffic.

As a result of the yellow sodium light, the lens of the eye does not have to make any special effort of accommodation to project a clear image upon the retina. If the colour of the light were, to take an extreme example, blue, special accommodation would indeed be necessary, and experience has taught that this produces uneasiness and causes fatigue. White

light contains all the colours of the spectrum. The eye is unable to convey all these colours in a combined, sharp image to the retina; the edges of the image become slightly blurred. Under reasonably strong lighting, this imperfection is not conspicuous. Under weak lighting, however, it is a disadvantage which makes itself felt above all when picking out objects a long distance away. It has been established by experience that visual acuteness under standard highway lighting with sodium lamps equals that under daylight conditions.

The sharply outlined image becomes even more distinct as a result of the phenomenon that dark surfaces manifest a lesser degree of brightness than they would do in a white light under otherwise identical circumstances. This phenomenon is a result of characteristics in the retina of the human eye. This might be expressed more simply by saying that the retina reacts normally to normal and slightly less than normal brightness of sodium light, but is insensitive to very slight intensities. Anything that is very dark, therefore, we see as black, and it is to this that sodium lighting owes its quality of contrast, which is about three times greater than that of other lighting.

GOOD VISIBILITY IN MIST AND FOG

The good results obtained with sodium lighting in unfavaurable weather conditions are most probably due to the kindly nature of sodium light itself. The illuminated veil of mist which takes up the whole field of vision causes only slight glare. The ability of the optic sensory system to perceive small changes in brightness contrasts is therefore far less affected than it would be in mist under white lighting. It is not the light radiation that penetrates better through the mist but the visual sense that reaches farther than it would in mist under another sort of lighting. Similar considerations also apply to the reflecting streaks on wet road surfaces and to drops on the windscreen which cause far less inconvenience than might be expected from their physical brightness.

The facts and phenomena dealt with in this article can be personally observed by anyone interested in the subject. Comparison is also possible, as the street and highway network is hung with the most widely diverging public lighting systems with a large variety of appertaining lamps and fittings.

Many good and even excellent lighting installations are found along our public highways, but, alas, there are still numerous examples that seem to have been erected more as a hindrance than as a help to the road user. These unfortunate creations, however, can at least do some service as a basis of comparison, so that they may make room as soon as possible for something more efficient.

RECORD TALK

LATEST ENGLISH EQUIPMENT

A recent visitor to Britain has commented on some of the recording equipment inspected there. The E. M. I. instruments he considers wonderful examples of beautiful design and workmanship. The quality of recording and reproduction from the elaborate studio model are as near perfection as one is likely to hear, while, not to be outdone, the performance of the portable at as low a speed as 3¾ in. per second was surprisingly good with very articulate speech bearing recognizable resemblance to the original.

He was also intrigued by the new H.M.V. piezo-electric pick-up using barium titanate as the piezo element. The advantages of this are that it is not so susceptible to temperature and hygroscopic changes as Rochelle salt, which is more generally used in pick-ups, but unfortunately it is just as fragile to shock as the latter. However, this is another example of H.M.V. enterprise which should not be allowed to escape unappreciated.

PYE GRAMOPHONE RECORD PLANS

According to a recent announcement, Pye Ltd. of Cambridge is to enter the field of gramophone record manufacture using the facilities and musical and technical experience of the well-known Nixa Record Co. A new company is to be formed in which both Pye and Nixa interests will be represented, and the records will continue to be marketed under the Nixa label

Nixa, of course, are very well known for their extensive list of high-quality long-playing records of classical music, including the Westminster recordngs whch have establshed a big reputation. The latest Nixa catalogue lists 322 ten and twelve-inch long-playing records, in addition to which Nixa have a list of approaching 200 standard 10 in. and 12 in. 78 r.p.m. records by Continental and other artists.

HOW TO CARE FOR GRAMOPHONE RECORDS

To prevent records warping, Mr. P. Wilson, M.A., the well-known contributor to "The Gramophone," gives the following hints:—

(1) They should be stored on edge and not flat.

(2) Each size must be stored separately and not intermixed.

(3) They should be in stiff envelopes with a definite side pressure on each; i.e., they should be packed tightly with stiff partitions between each 50 records or so.

(4) Each square envelope with circular record inside will be empty at the corners. When abstracting the record advantage is taken of this fact by taking hold of the top empty corner and pulling the envelope forward a little. It is then easy to abstract the record, leaving the envelope in its correct place.

NEW MAGNETIC RECORDING TAPE

As a result of development work initiated by British Insulated Callender's Cables Ltd. two years ago and since continued by the M.S.S. Recording Co. Ltd., the latter Company is now producing a magnetic recording tape (type A.M.15) of high quality, medium coercivity, particularly suitable for use with low-speed recording machines operating at 7½ in. and 3¾ in. per second. The very smooth finish of the tape is claimed to guarantee a high performance and to cause minimum wear on recording and play-back heads.

RECORD SLEEVES

Undoubtedly, the advent of L.P.s has been hailed with much satisfaction by record-lovers the world over.

Not the least among their good qualities is the educative value of the material contained on the backs of the record sleeves, be it an article on the composer of the music, the music itself, some subject closely allied to it, or perhaps a combination of all three.

Since the demise of the cylindrical phonograph record, the public have had to accept record covers of unpretentious brown paper. Now and again, of course, when issuing a recording occupying 8 or 10 sides, the manufacturer provided an album and accompanying printed notes, but, apart from these and occasional notes issued with special recordings, blank brown paper reigned supreme!

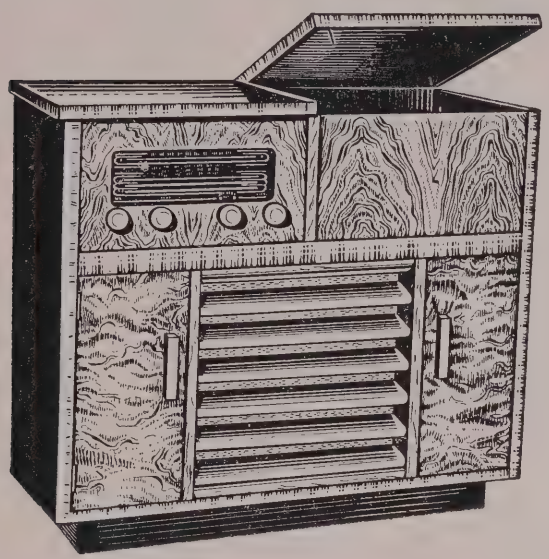
It is no good putting new wine into old bottles, however, so the new L.P.s deserved a different packaging, even if only to protect their delicate surfaces. Whether the first programme notes were prompted by the sales angle or merely the Manufacturer's desire to utilise attractively the reverse side of the sleeve, is a matter of little concern compared with the tremendous importance of this new educative medium.

Statistics reveal remarkable increases in record sales, and quite apart from the sales opportunities which these sleeves promote for the trader, they must play an ever increasing part in the general musical education of New Zealanders. Are we, as members of the general record-loving public, sufficiently appreciative of this well-written and authorative information so freely put at our disposal by leading British record manufacturers?

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

THE "ULTIMATE" BABY GRAND



The music-lover will be thrilled to see and hear this brand-new radiogram produced by Ultimate. The Ultimate Baby Grand is a handsome, superbly designed, 7-valve bandspread Lowboy Radio-gramophone. It is designed for the maximum listening pleasure, with a dial at comfort level and simple controls located for easy tuning.

The Ultimate Baby Grand is a powerful radio with de luxe selectivity and sensitivity, bandspread tuning, and a 12 in. pre-tested Rola speaker. Large colourful floodlit dial has wide station separation, and waveband selection is simple, positive, and comprehensive.

The Ultimate Baby Grand uses a fully automatic 3-speed Garrard de luxe record changer, with twin crystal turnover head and a 1½ in. spindle for the accommodation of 45 r.p.m. 7 in. discs.

The Ultimate Baby Grand has a large baffle area and is relieved by six smoothly shaped wooden louvres. It combines the best features of modern styling with maximum tonal response.

The dimensions are: 3 ft. 0¼ in. long, 2 ft. 8¼ in. high, 1 ft. 4¾ in. deep.

The Ultimate Baby Grand retails at £135 6s. 8d.

* * *

"SOLIGHT" DOMESTIC RANGE

This new "Solight" Domestic Range has an extra large oven which uses only 800 watts of power by "reflected heat" from four ordinary 200-watt household lamps. Specifications of the range are: 37 in. high, 26 in. wide, and 17 in. deep, with an oven 21 in. x 14 in. x 12 in. and a spacious storage compartment underneath. The "Solight" oven will cook anything in the same time as an ordinary open-element type of stove of 3,000 watts. Fitted with three standard hot-plates, the "Solight" Range has a total loading of only 5,400 watts. Fully guaranteed for 12 months (including lamps), this new cooking

appliance will be welcomed by the public not only for its power economy but for its extra large oven, cleanliness, and excellent cooking capabilities. Supplies are expected to be available at the end of the month.

Trade Winds

H.M.V. (N.Z.) LTD.

In Auckland, as a result of the demonstrations at the popular Easter Show, TV continues to be the talk of the day. Besides the demonstrations upon which we reported on page 32 of our May issue, those of the E.M.I. Industrial TV camera attracted much attention. This closed circuit unit operates on B.B.C. standards—e.g., 405 lines, etc., and when pointed at viewers created much amusement among the latter, who were able to see themselves on the TV receivers in the H.M.V. stand.

Latest model H.M.V. high-definition TV receivers with black-and-white screens were also on show and were used to pick up TV broadcast programmes transmitted from the Showgrounds. In spite of the small power used by the transmitter, good-quality pictures were obtained on H.M.V. receivers at Otahuhu, Murangi Bay, Mt. Roskill, Remuera, and Queen Street. These receiyers enabled many hundreds of people to see TV for the first time, the general verdict being favourable. Housewives, prepare! As an indication of things to come, we discovered that in all homes where a TV receiver was installed, the normal routine was completely upset by hordes of invited, and in many cases uninvited, guests, who flocked to watch the programmes.

Though perhaps television was the main attraction, the H.M.V. stands Nos. 7 and 8 also featured the popular H.M.V. refrigerators, washing machines, household appliances, radios and records, and the new radio control equipment.

Coupled with the latter was a series of radio control demonstrations given by Mr. L. H. Wright, when a model aeroplane, controlled from the ground by radio, was made to perform stunts and manoeuvres above the crowd, the plane later making safe landings on the adjacent racecourse.

* * *

NEW FACTORY FOR ELECTRIC UTILITIES

Electric Utilities Co. Ltd., manufacturers of the well-known Eutron Heating Elements, report the purchase of an additional factory in Auckland. This factory, which has double the floor space of their present premises, will allow for the expansion of production of existing lines and for the manufacture of additional types of elements now in the course of development. The company reports a large increase in the demand for various elements, particularly for use in open air and for purposes other than water-heating. As soon as these new lines are in production, full details will be supplied to the trade. Electric Utilities Co. Ltd. will continue to use their existing factory, and the administration of the company will, as in the past, be conducted from their present address.

* * *

RADIO PRODUCTION AND TV RESEARCH IN AUSTRALIA

Although production is lower than in the boom period of 1951-52, Australian radio and electrical business is thriving, and figures for December show that manufacturers turned out some 40,000 receivers for the month.

This information was brought back by Mr. Harold Brown, general manager, Loudspeakers (N.Z.) Ltd., who has just returned from a visit to the Melbourne headquarters of Rola Company (Aust.) Pty, Ltd., where he discussed latest developments in loudspeaker design and manufacture.

Mr. Brown found that the 40,000 Australian radio sets produced in December were divided broadly as follows:—

Type	Quantity	Av. retail price
Mantel and table models	16,500	Mantel, £21 Table, £35
Portables	11,000	£30
Car radios	5,000	£50
Radiograms	7,000	£50 to £200

The most popular radiograms were those retailing at around 100. The most widely used speaker in these units is the 12 in. Rola Model 12J. Even the cheapest units are fitted with 3-speed record changers. A large percentage of Australian radiograms are made by a group of small manufacturers, who supply them to department stores and furniture houses. These latter sell the units under their own brand names. Some are sold complete with 3-speed changer and 12 in. speaker at under £50.

Analysing Mr. Brown's figures, it will be found that the retail value of Australia's December radio production was around £A1,600,000.

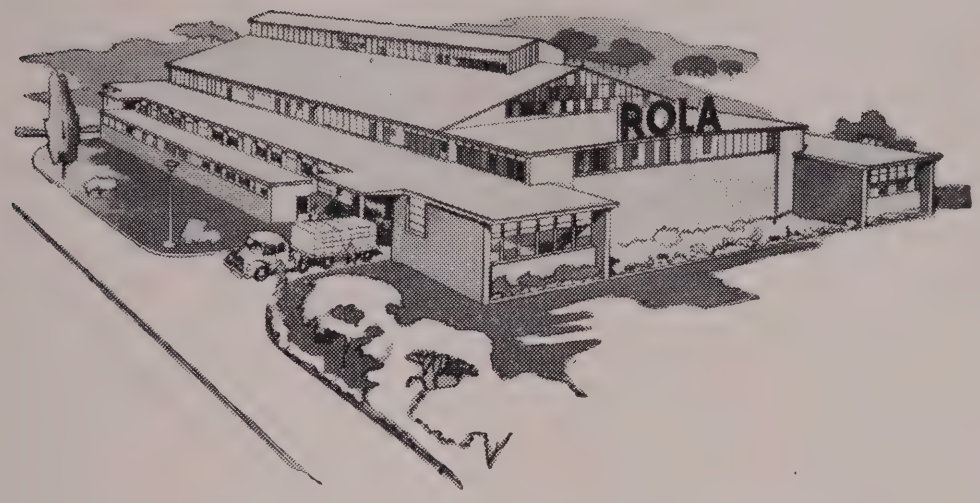
Though the Royal visit gave an important fillip to radio sales, there is no indication of any but the usual seasonal decline in January, February, and March, and the figures for these months are higher than for the corresponding period last year.

Television is getting top priority thinking from Australian manufacturers. The A.W.A. telecasting of the Royal visit to Sydney and Brisbane created terrific interest and showed how eagerly the medium will be adopted by the Australian public.

Though both trade and public impatiently awaited publication of the findings of the Royal Commission, no move to implement its recommendations appears to be likely until after the Federal election. One school of thought believes that television may feature in the election promises of the retiring Menzies Government.

Meantime, a great deal of television research work is being conducted by Australian radio manufacturers, some of which have already made pilot receivers and installed television test equipment.

Amongst those whose plans are well advanced is Rola Company (Aust.) Pty. Ltd., which proposes to manufacture specialized components for use in television receivers. Some of these Rola components are already being evaluated by major manufacturers who plan television production. Rola television components will follow the very latest American practice, and the know-how of their design and construction is the outcome of a long-standing exchange of technical information between Rola Company (Aust.) Pty. Ltd. and the Rola Company Inc., Cleveland, U.S.A.



Artist's view of Rola's new Springvale factory.

One of the most important developments in the Australian magnet winding wire industry since it was established by Rola Company (Aust.) Pty. Ltd. at Richmond, Victoria, in 1940, is the announcement by this organization that early next June it will transfer its wire plant to a big new factory at Springvale, 15 miles from Melbourne.

The move is dictated by the necessity for major expansion to meet the Australian and New Zealand demand for Rola wires, and at the same time to provide for the company's proposed manufacture of television components in the Richmond plant.

The Springvale plant is being erected on a 7½-acre site handy to the Victorian State Electricity Commission supply line and on the route of the big high-pressure pipe line which next year will carry gas made from brown coal 95 miles from Morwell to Melbourne.

The first unit of the new plant will be a 30,000-square-foot steel, brick and concrete building of specialized design. It will have an aluminium roof to provide maximum heat radiation and to reduce fire hazard. This is one of the first large aluminium roofed structures to be erected in Australia.

New plant ordered from abroad is awaiting installation and more is on the way. When completed, the new Rola wire plant will be the most modern of its type and equal to the best overseas units. Its capacity is planned to meet the Australian and New Zealand magnet wire requirements.

* * *

OVERSEAS TOUR—MR. A. J. WYNESS

As announced in our May issue, Mr. A. J. Wyness, of H.M.V. (N.Z.) Ltd., is at present travelling in Britain and America to observe overseas trends and to visit his firm's principals. Accompanied by his wife, Mr. Wyness is travelling by ship, and expects to be away approximately six months.

Meantime, the firm is being capably managed by Mr. S. Heginbotham and Mr. L. H. Wright on the administrative and technical sides respectively, and clients can be assured of the usual efficient H.M.V. service.

* * *

MATRIX DEPARTMENT OF H.M.V. (N.Z.) LTD.

With the expansion of H.M.V. record-pressing facilities, it has been found necessary to step up the matrix and recording section, and latest appointment to this branch is Mr. K. McEwan, late of Telecommunications Ltd.

Ken has all our best wishes in this interesting job, where we know he can combine his hobby with his work. We expect big things of H.M.V. now!

CHANGE OF ADDRESS

When you change your address, be sure to notify the Subscription Department, "Radio and Electrical Review," P.O. Box 8022, Wellington, New Zealand, and do this at least four weeks in advance. To avoid disappointment through not receiving your copy of "Radio and Electrical Review," should it go to the wrong address through your failure to notify us of a change, we earnestly ask for your co-operation in this important matter.

NEW ZEALAND RADIO AND ELECTRICAL TRADERS' FEDERATION ANNUAL REPORT

MR. N. SOUPER

In presenting his report to the Annual Conference of the New Zealand Radio and Electrical Traders' Federation held in Wellington on the 25th and 26th May, the President, Mr. N. Souper, remarked on the successful trading conditions which had prevailed during the past year, wryly commenting upon the way in which this happy state of affairs was reflected in poor attendance at meetings. Emphasizing the need for unity at all levels, he appealed to members to show more interest in the affairs of the Federation, whose officers laboured diligently for the benefit of all.

With supplies of radio sets and electrical equipment much freer than in the past, the trade has been able to offer the public a variety of goods reminiscent of pre-war days. Prices had a definite falling tendency prior to the last general wage increase, the effect of which has been to raise prices of all goods again. Mr. Souper confessed to difficulty in following the Arbitration Court's reason for the 10% increase, and could not speak too strongly against the order for retrospective pay, for which there was no justification, and which had proved a real burden to the employer.

A pressing problem requiring concerted action by both listeners and members of the trade is that of electrical interference, which has now reached such proportions that, in many cities, listeners are limited to "local stations." Though a Government Committee to investigate means of reducing electrical interference was set up some three years ago, very little seems to have been done. The Post and Telegraph Department has co-operated to the best of its ability, but is hindered by lack of authority. United action by the whole of the radio industry is required to overcome this problem, and for its part, the New Zealand Radio and Electrical Traders' Federation intends to press this subject to the utmost.

The value of a united front was demonstrated by the extension of broadcasting hours during the past year. Here, through the activities of its President and widespread Federation publicity and press comment on this subject, the Federation undoubtedly proved the vital factor in securing the additional hours.

Mr. Souper considered that, in view of rising costs, the recent increase in licence fees could scarcely be challenged, but he warned members of the necessity to see that this money was used for specific broadcasting purposes, and not for the financing of other projects, however worthy they may be.

During the year, in an effort to attract more apprentices to the trade, the Federation had printed and distributed to all secondary schools and technical colleges 25,000 leaflets explaining the advantages of a career offered by the industry. As yet, of course, it is too early to judge the results, but already, from inquiries received, it is apparent that these leaflets have aroused considerable interest in the lads about to leave school.

In an endeavour to overcome the problem of "dabblers" in the trade, the Federation is preparing a list of accredited dealers, by means of which it is hoped to prevent the abuse of the dealer's licence. Representations are to be made to the Minister to limit the issuing of dealers' licences to those who have a recognized place of business, and who devote their full time to the industry.

The Government's recent statement concerning the unlikelihood of the introduction of TV in New Zealand in the near future has helped arrest the uncertainty in the radio industry. Prior to this announcement, in the belief that the introduction of TV was imminent, the public was hesitant about purchasing new radio sets. Notwithstanding the Goverment's statement, however, traders must prepare for a TV future and ensure that they can render the public the same high standard of service as exists in the radio industry today. Technical colleges and various other reliable institutions are providing the necessary classes of instruction, and Federation members should ensure that their servicemen take advantage of these classes to acquire a full understanding of this vast new field.

In thanking the Editor of the Bulletin, Mr. W. Young, for his valued services, Mr. Souper appealed to members to assist with contributions, which would greatly ease the Editor's burden.

Mr. Souper also expressed his thanks to the Vice-President, members of the Executive, the Federation Secretary and his staff, and to the Federation official organ, "Radio and Electronics" (now known as "Radio and Electrical Review") for all assistance rendered during his term of office.

NEWS FROM GOVERNMENT DEPARTMENTS

ELECTRONIC DIRECTORS FOR TELEPHONE EXCHANGES

New Zealand Post Office telephone engineers are following with interest British Post Office experiments with electronic directors for telephone exchanges.

During recent years, there have been very rapid advances in the development of electronic techniques and in their application to a wide variety of purposes, such as the construction of computors and the so-called "electronic brain." British Post Office engineers at the Dollis Hill Research Station have been studying the application of these techniques to automatic telephone exchanges. Their aim is to provide telephone exchanges operated entirely by electronic means instead of by the present type of electro-mechanical switch. The electronic apparatus has no moving parts, it is almost instantaneous in operation, and may eventually prove cheaper to install and maintain than our present-day exchanges.

Six electronic directors which were constructed in the British Post Office Laboratories were brought into service at Richmond telephone exchange in London about two years ago. These have been carrying public traffic since then, and it is a tribute to the soundness of the principles on which they are designed that, although they are only experimental units, their performance compares very favourably with that of the older electro-mechanical equipment.

The director is that part of the exchange equipment which steers a call to the wanted exchange within a city network. A single director does this for about half a million calls a year; with the present type of electro-mechanical director, the operation is somewhat noisy, and there is a good deal of mechanical wear brought about by the hard usage. The electronic director has no moving parts and does its work silently.

The original experimental installation at Richmond was the first instance of the use of a fully electronic item of switching equipment in a public telephone system in the world, and placed Britain in the front line of development in this new field.

RADIO NEW ZEALAND FREQUENCIES

Since Friday, April 23, 1954 (New Zealand date), Radio New Zealand has been operating in accordance with the following schedule:—

1. TO AUSTRALIA

1800-2045 GMT	ZL18	9.52 Mc/s in 31 Metre Band
2100-0445 GMT	ZL19	11.83 Mc/s in 25 Metre Band
0500-Close-Down	ZL18	9.52 Mc/s in 31 Metre Band

2. TO PACIFIC ISLANDS

1800-2045 GMT	ZL2	9.45 Mc/s in 31 Metre Band
2100-0445 GMT	ZL3	11.78 Mc/s in 25 Metre Band
0500-Close-Down	ZL2	9.45 Mc/s in 31 Metre Band

At the present time Close-down is: 1045 GMT on week-days; 1120 GMT on Saturdays; 1000 GMT on Sundays.

Call sign	Frequency (Mc/s.)	Wave-length (Metres)
ZL7	6.08	49.34
ZL11	6.13	48.94
ZL12	7.22	41.55
ZL13	7.29	41.15
ZL18	9.52	31.51
ZL2	9.54	31.45
ZL8	9.62	31.19
ZL3	11.78	25.47
ZL9	11.81	25.40
ZL10	15.22	19.71
ZL4	15.28	19.63
ZL5	17.77	16.88
ZL14	17.82	16.84
ZL15	21.48	13.97
ZL16	21.58	13.90
ZL6	25.80	11.63
ZL17	26.00	11.54

The two transmitters used by Radio New Zealand are at Titahi Bay, some seventeen miles from the studios in Wellington City. Each transmitter has a radiated energy of 7.5 kilowatts. Two of the above seventeen frequencies are used simultaneously, and as the programme service is intended primarily for Australia and the Pacific Islands, the present aerials are beamed in those two directions.

MR. T. SPENCER

Mr. Spencer, who is Managing Director of Akrad Radio Corporation's factory at Waihi left last month on a trip to U.K., where he will view and discuss the latest radio and TV developments with Messrs. Pye Ltd., Cambridge.

INSIGNIA AWARD IN TECHNOLOGY

Many New Zealanders may be interested to hear of the Insignia Award in Technology established by the City and Guilds of London some twelve months ago. The object of this award is to provide a high qualification for persons in industry with initial training based primarily upon practical experience, combined with theoretical study, and who, having gained appropriate City and Guilds' Certificates as craftsmen or technicians, have advanced in their industry by a combination of progressive experience and further study. The conditions require a candidate to be at least 30 years of age and have three sponsors of appropriate standing. He must have been apprenticed or otherwise suitably trained in his industry, must hold relevant full technological certificates of the Institute, and have had a minimum of seven years' progressive experience in his industry. In addition, he must submit a thesis of some 10,000 to 20,000 words on a technological topic associated with his work. If this thesis earns satisfactory commendation from the Assessor appointed by the Institute, the candidate is required to appear for an interview before an ad hoc panel nominated by the Institute for this purpose. A candidate upon whom the Insignia Award in Technology is conferred receives a Warrant specifying thereon the section in which his knowledge and skill are recognised, and, under the Institute's Royal Charter, he is authorised to use the insignia letters C.G.I.A. No special time table is involved in this scheme, each candidate receiving separate treatment, and great care being taken to assist him at all stages of his candidature.

Further details may be obtained from the City and Guilds of London Institute, Department of Technology, 31 Brechin Place, South Kensington, London, S.W.7.

* * *

ELECTRICAL EXHIBITION IN MELBOURNE

For two weeks in October of this year, the Exhibition Building, Melbourne, will be the scene of an Electrical Industries Fair organized by the Electrical and Radio Federation, Dominion Chambers, 59 William Street, Melbourne. Further information may be obtained from the Manager of the Federation at the above address.

FOR THE TECHNICIAN

MORPHY-RICHARDS TOASTER

(*Continued from May,* 1954)

3—FAULT FINDING

Your customer's complaint may clearly indicate the fault but we strongly advise you to check the points mentioned in section 2 to ensure that future possible sources of trouble are removed.

Loading arm will not engage.—Press white trip button and try again as relay arm may be already engaged in timer, due either to a weak relay arm spring or a jolt having shaken relay arm down. If no cure, remove cowl. Check whether toaster frame has shifted or handle bracket is loose in its bearings, or bent. Is trip lever jammed back due to rust, etc., at spindle? Is pawl spring broken, allowing pawl to remain back?

Burns toast.—Is toaster correct voltage? Is time cycle correct? (refer to section 2—14); if not, replace timer.

Toast is underdone.—Is voltage correct? Is time cycle correct? (refer to section 2—14); if not, replace timer.

Toast is not ejected.—Is loading arm in position? Does loading take place against spring opposition? Is bread too thick and jamming in guides? Is relay arm spring weak, Is daspot loose?

Loading arm engages but elements do not glow.—Are main contacts making? If not, give them a downward set and try again. Check for supply to toaster mains. Check for dust between timer contact, and check elements for continuity, if no cure fit new timer.

Only elements in one chamber glow.—One element is open circuit; locate and replace.

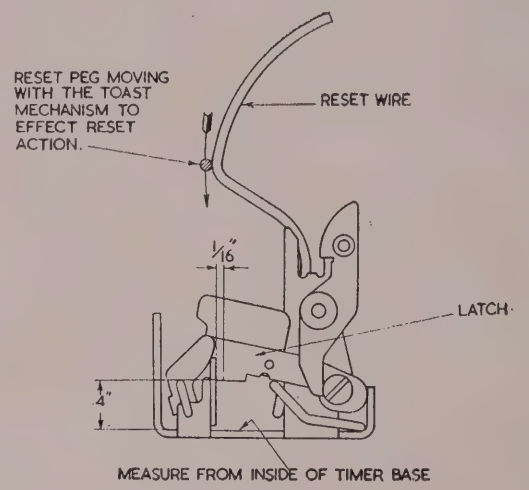
Contacts are welded together.—It will be apparent that the toaster has been used on D.C. mains and such use is not now recommended.

4—TIMER

(Brief description of the Morphy-Richards Toaster Timer action)

Mains are connected through contacts mounted on pillars and the circuit is completed when the contacts are joined by loading arm engagement. When the circuit is complete the bi-metal is heated by the element mounted on it. The bi-metal is designed to carry the stop bracket (which is riveted to it) forward until it is arrested by the cam of the browning control device. This movement is called the preferential movement, the free end of the bi-metal curls inwards and it is important to check that the stop bracket has been arrested by the cam before the bi-metal reaches the step in the latch.

When the bi-metal reaches the step in the latch, the latch drops and carries with it the latch pad on which two contacts are resting. The rear contact which is the short circuit is closed by the action of the latch drop and the circuit to the bi-metal heater is by-passed. The bi-metal now starts to cool and to return to its original position. As it does so, it carries with it the latch and in turn the pawl which releases the relay arm. This relay arm in turn releases the loading arm and as this has been engaged against the opposition of a spring it will move upwards to lift the toast. As the loading arm moves upward the reset peg mounted on it carries the reset wire rearwards. The reset wire lifts the latch of the bi-metal, breaks the auxiliary and short circuit contacts and returns to its normal position, allowing the auxiliary contact to make and the short circuit contacts to remain open.



Hold off latch

The hold off latch is situated immediately in front of the browning control knob. Its purpose is to prevent the timer from restarting half way through a cycle should the trip lever have been used. For example, if a piece of bread was sufficiently toasted on its first cycle and was replaced for further toasting, it would not require a full time cycle and the trip button would be used to eject the bread when satisfactorily toasted. At the time that the trip button was pressed the bi-metal would be already some way along its travel. Now if immediate reloading took place, the toast would be ejected under done as part of the cycle would have been already completed. To prevent this happening, as the latch is lifted by the action of the reset wire, the J shaped pin moves forward under the latch and prevents it falling to close the auxiliary contact, toasting cannot therefore begin. As the bi-metal cooling proceeds and its backward travel continues, it pushes with it the latch which carried the J pin and finally pushes the pin clear of the latch; the latch is therefore allowed to fall and remake the auxiliary contacts. When this is done the circuit to the elements will be complete and toasting will start again.

Timer Servicing

Timer setting. First set the contact gaps. Looking from the latch end, the left contact is the auxiliary and the right the short circuit. The gap between the short circuit contacts should be between .030 inch and .040 inch and the gap between the auxiliary contact tip and the top of the latch should be approximately .020 inch. Set the browning control to $3\frac{1}{2}$ and

switch on the mains, controlling the voltage at a value in the middle of the range. Now time the bi-metal travel until it reaches the step in the latch. This should be between 1 min. 44 sec. and 2min. 24 sec. starting from cold. When the bi-metal reaches this step, the latch will fall, and allow the short circuit contacts to close. The forward movement of the bi-metal should now stop, but if it continues to move forward it indicates that either the latch has not dropped completely, probably because it is binding due to dirt, or that there is dirt between the short circuit contacts. Clean these contacts and check the pressure between them (4½ ounces on the short circuit and 1½ ounces on the auxiliary contacts). If the bi-metal movement reverses as it should do the time between the latch dropping and the tripping of the relay arm should be between 36 sec. and 46 sec.

Reset wire. Check the action of the reset wire as follows:

Hold the toast carriage so that the reset wire is pushed inwards the greatest distance. (About 1 inch from the engaged position). The distance from the timer base to the latch should be as shown in the diagram.

Test. Ensure that latch pad is raised sufficiently to enable the hold-off latch to go forward to rest underneath the latch pad, thus allowing both sets of contacts to be open circuit. This adjustment must be made with the bi-metal held forward. It may be found necessary to bend out the reset wire very slightly if the above setting is unobtainable.

Insulation. Check that the nickel strips or other bare current carrying wires are not touching any other metal part.

Modifications to Timers (Timers produced in 1949 are for Model TA/1)

The following modifications were introduced during the year:

(i) Reset wire gauge made heavier.

(ii) The extreme ends of the short circuit contacts were turned upwards at the edges to prevent jamming on the latch pad.

(iii) The leads from the switch pack which were nickel strips were replaced by glass covered leads.

(iv) A leaf spring replaced the former helical spring on the relay arm.

(v) A guide pin was fitted through the bi-metal to prevent it lifting and opening the auxiliary contacts.

(vi) The switch pack assembly has been modified to enable both leads to be connected on the side which prevents fouling by the handle bracket.

Model TA/1B (1950 Production) is similar to the TA/1 except that the pillars carrying the contacts are set forward. This makes it necessary to adjust the position of the main timer contacts with the toaster contacts when fitting a new timer to a TA1 model toaster frame.

5—CARRIER AND LOADING ARM

Model TA/1 1949 Production

The following faults may be found on the carrier and loading arm assembly.

(i) Carrier arm may be too short to engage with the relay arm. Fault is probably due to a frame shift following a fall.

(ii) Carrier arm catches on frame. Bend it gently back into position.

(iii) Carrier catches on guide wires. One or the other has been distorted and should be straightened.

(iv) Handle bearings loose. Tighten appropriate screws, or reform plate to provide better bearing.

(v) Handle bracket out of bearings, reform plate and tighten screws.

(vi) Handle bracket bent. Straighten.

(vii) Handle bracket short circuited to timer screw. Straighten.

It will be seen that the above faults are all mechanical and easily rectified.

Model TA/1B (1950)

This model has been designed to prevent most of the above troubles. The frame is cross braced and carrier and loading are are of improved construction and mounting. The carrier arm has a bracket added which engages with the dashpot plunger. This dashpot limits the rate of rise of the bread carrier to prevent the toast from being thrown out of the toaster.

6—ELEMENTS

Element failures are usually in one of the following categories: (1) Open circuits; (2) Tape parted at spot weld; (3) Short circuits.

In toasters of the following voltages—240/250, 220/235, 220/215—the elements of each chamber are connected in series and a failure in one element will result therefore in a pair of elements being open circuit. If one toast chamber fails to heat up remove the three binding screws of the element connections and test each element separately for continuity.

If a fault has been located

(i) Open the crumb tray.

(ii) Spring the guide wires inwards at the bottom end and lift clear of the slots and then press them upwards to clear the top locating slots.

(iii) Now withdraw the element and reflector.

(iv) Fit new element and ensure that it fits well down in the reflector. Ensure that the correct voltage element is used.

(v) Replace guide wires and ensure that the element is tucked well behind their bottom bend.

(vi) Remake connections and check insulation by twisting both mains leads together and testing between them and earth.

Check insulation with toaster both latched and unlatched.

7—FRAME, BASE MOULDINGS, CRUMB TRAY

Frame

Early models Type TA/1 were supplied without cross and end bracing. It is possible for these to have become distorted due to rough handling. Such distortion may cause the contacts to be out of line, jamming the loading arm against the relay arm and jamming of the bread carrier against the frame or guide wires. It may be fairly easy to correct this fault by pushing the frame into shape.

Base Mounting

Damaged base mouldings are easily replaced. After removing the base plates, cowl and connections, re-

move two screws mounting them to chassis. The timer mechanism is screwed to the base plate by three screws.

Crumb Tray

The crumb tray should not cause any trouble unless damaged. If a replacement is required, the old one is removed by pushing out its hinge pin.

The crumb tray catch may give trouble occasionally, due to sticking in its seating. It is secured by one screw to the base moulding and is easily removed after removal of the base. Having removed the catch, ease the seating with a smooth file. Replace broken springs.

8—TESTING

(i) Check insulation of both leads to earth.

(ii) Check Mechanical operation of loading arm, and bread carrier. See that they operate smoothly and do not scrape the frame.

(iii) See that main contacts make properly.

(iv) Test tripping mechanism and note that relay arm does not jam in the guide way.

(v) Make sure that naked bi-metal leads, if fitted, are clear of earth.

(vi) See that loading arm is clear of bi-metal leads.

(vii) Switch on and check timing. Toaster should eject between 2 min. 20 sec. and 3 min. 10 sec. from cold, when set at 3½.

9—COWL

The cowl is composed of two sides and one arch held together by four lugs, two at each end of the arch. To replace a side, first remove the old side by very carefully lifting up the lugs which hold it. If a lug is broken the arch may be joined to the side by carefully applied soft solder. Great care must be taken to ensure that this solder is invisible externally.

Sides are obtainable separately, from your normal spares suppliers.

10—RE-ASSEMBLY

Having tested the toaster electrically and mechanically, without the cowl, it should now be finally assembled.

Great care should be taken when replacing the cowl to avoid damaging the timer mechanism.

Lower the cowl over the toaster frame, keeping it well clear of the timer end, allowing the cowl edge to enter the frame cut outs at the end of the toaster at which the cord enters, so that the cowl lip can pass over the adjusting spindle.

If you have any difficulty in obtaining the correct engagement between the push button and the trip lever, tilt the toaster upwards at the timer end as the cowl is drawn forward and lowered into the correct position. Tilting allows the trip lever to fall back clear of the push button screw head. Turn the toaster base upwards and replace the four spire nuts and screws which retain the cowl. Replace any missing cork feet using Bostick "C" cement or similar adhesive.

Refit the moving handle and ensure that the fibre roller is in position.

Turn toaster upright. Chech mechanical functioning. Clean ready for despatch.

It is necessary to check timing after fitting the cowl and to ensure that everything is satisfactory. Provided the appliance is quite cold however, there should be no difference to previous check timing.

MISSING AND STOLEN RADIOS

AUCKLAND:

Four Autocrat car radios, Serial Nos. 14258, 14267, 14269, 14281. Each set in two units, four-valve tuning unit 7 in. x 6 in. x 2½ in., with two control knobs, and four-valve speaker unit 9 in. x 4½ in. x 5 in. with switch. Made for Morris 8; 12-volt battery control.

Regent radiogram, Serial No. 26138; 4-valve radio; 3-speed B.S.R. gramophone. Lid of radio gives access to gramophone; radio dial on right, speaker on left; 4 tuning knobs below dial; brown varnished wooden cabinet.

Mullard 4-valve mantel model radio, Serial No. 53960; mushroom plastic case.

PHILCO 1939 dual-wave, 5 or 6-valve mantel model: dark varnished cabinet, 18 in. x 24 in.

PYE 5-valve mantel radio, serial No. 27606: brown plastic cabinet, 18 in. x 10 in. x 10 in., with white front and 4 brown tuning knobs; square dial.

PHILIPS 4-valve single record player, model No. 208, serial No. 28330.

OTOROHANGA:

Autocrat car radio, 8 valves, 6 volt, Serial No. 14539; brown case.

MANGAKINO:

Pacemaker battery/electric portable, Serial No. 5150 A B 93999. Maroon plastic case, roller type front cracked. Radio in need of minor repairs.

PATEA:

Ultimate 6-valve model, Serial No. R.A.W. 155535.

WELLINGTON:

Gulbransen 5-valve, broadcast, Serial No. 23592; white plastic cabinet.

A.R.C. Victor broadcast, table model, chassis No. 22998a, model No. 5153. Dark mahogany plastic case; clockface dial.

Courier 5-valve broadcast mantle model, 110 volts, AC/DC; wooden cabinet 18 in. x 12 in. x 8 in. Missing suppressor.

Five-valve home-made 12-volt auto radio receiver in aluminium case 7 in. x 6 in. x 5 in., with perspex slide-rule dial, 4½ in. x 2 in., with name "Gardner" engraved thereon. Valves: two 12SK7, one 12A6, one 12SR7, one 12K8.

LOWER HUTT:

Pacemaker battery/electric portable, Serial No. 97879.

CHRISTCHURCH:

Aeriel 6-valve battery/electric new portable radio, Serial No. X5295. Maroon bakelite case 10 in. x 6 in. x 4 in., with retractable handle.

Cromwell 6-valve broadcast push-button radio; unusual design, with cabinet rounded at one corner near speaker.

Ultimate 5-valve broadcast mantel model, Serial No. 146822, brown bakelite case.

Chevrolet car radio speaker with built-in dial.

TIMARU:

Pacemaker 6-volt, 7-valve car radio, Serial No. 21730/20575; copper sand-coloured cabinet.

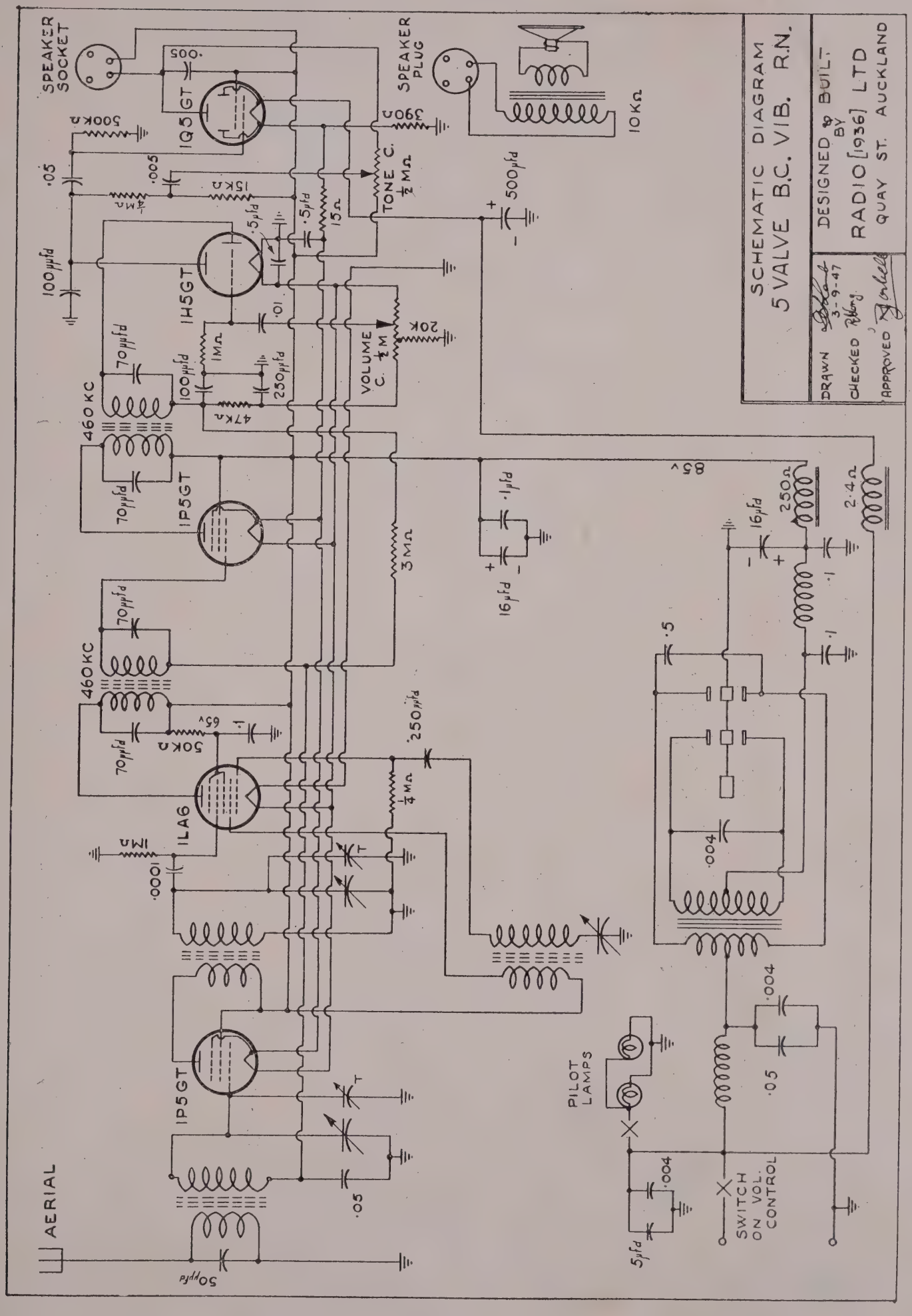
DUNEDIN:

Pacemaker 5-valve portable, Serial No. 28883/66740; burgundy and ivory cabinet.

Philco model 354, Serial No. 37705.

Ultimate 5-valve broadcast, electric radio, probably 1952 model; Serial No. either 5291 or 5921.

THE ULTIMATE MODEL R.N.



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"Data and Circuits of Television Receiver Valves," by J. Jager—Philips's Technical Library. Philips Gloeilampenfabrieken, The Netherlands.

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"A.P.A.E. Journal," Vol. 5, No. 1, January, 1954.

"The Gramophone," Vol. XXXI, No. 368, January, 1954.

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N.Z. AMATEUR RADIO TRANSMITTERS' ASSOCIATION NEWS

The Trades' Hall, Vivian Street, Wellington, will be the venue of the N.Z.A.R.T. Annual Conference during the Queen's Birthday weekend.

Saturday, June 5th, will be devoted to business during the day, with a dinner and social gathering in the evening at the Trades' Hall. Other events on Sunday 6th and Monday 7th include a meeting of the Amateur Radio Emergency Corps on the Sunday morning, a mobile contest, a meeting of V.H.F. enthusiasts and several technical demonstrations.

Chairman of the Conference will be Dominion President, R. Hanley, ZL2GU, while the A.R.E.C. meeting will be conducted by W. D. Gorman, ZL2IY. Secretary of the Convention Organizing Committee is Mr. J. H. Mowtell of 12 Wha Street, Wellington, E.3.

RADIO ROUNDABOUT

ADDENDA TO "RADIOTRON DESIGNER'S HANDBOOK"

Amalgamated Wireless Valve Co. Pty. Ltd., announces the issue of an Addenda to the fourth edition of the "RADIOTRON DESIGNER'S HANDBOOK" by F. Langford-Smith.

A copy of this document will be issued freely to any holder of the "Radiotron Designer's Handbook" upon application being made to Amalgamated Wireless (A'sia) Ltd., P.O. Box 830, Wellington.

NEWS FROM E.M.I.

A recent vsitor to the E.M.I. factory at Hayes, Middlesex, England, was astonished at the tremendous progress made in the tube factory since his last visit only two years ago. Whereas, previously, only one rotary shaker machine was applying the fluorescent screen to a few 10 in. tubes, today three such machines are dealing with 12, 14, 15 and 17 in. types. Now, also, there is a rotary aluminising plant in full operation while a gigantic plant, reminiscent of a large scale model railway, ages and tests tubes by the hundred. Tube production figures are in the five figure region, with 14 in. and 17 in. types being produced in large quantities. Even the slight dislocation in the set factory, caused through the recent fire, has been overcome most successfully, and production is now back to normal.

To develop broadcasting facilities throughout the country, the Ministry of Communications of the Argentine has placed an order for British tape recording equipment to the value of £30,000 with E.M.I. for large quantities of recording tape and 32 E.M.I. magnetic tape recorders similar to those used by the British Broadcasting Corporation.

An order valued at over £100,000 has been placed with E.M.I. Factories by the French Air Ministry for 100 airborne Rebecca Mark IV sets, with spares and associated test gear.

E.M.I. have also received an order from the Swiss Post Office for a further three complete EMITRON mobile television microwave radio links.

ESSAY COMPETITION

Scientific Research in Industry.—The British Journal, "Research" is sponsoring a special essay competition in which prizes of £100 and £50 are to be awarded for the best and second-best entries.

Subject of the essay is any recent scientific discovery and its applications in industry, or any item of industrial research work which the competitor considers should be undertaken. Entries should be of approximately 3,500 words, and must be written without technical jargon, so that they may be understood by a board of directors or management committee with no specialist knowledge. Entries must be received by the publishers of "Research," Butterworths Scientific Publications, 88 Kingsway London, W.C.2., by 30th June, 1954, and the competitors must be able to prove that they are engaged on scientific research.

In addition to the ordinary prizes, two special ones of £100 and £50 are to be awarded by the "Sunday Times," London,

for entries suitable for publication in a general newspaper, and which relate to one of the following subjects: application of atomic energy; aerodynamics; conservation or utilization of fuel; electronics in business efficiency.

Further details may be obtained from the publishers of "Research."

ELECTRONIC DEVELOPMENTS IN SWEDEN

From Sweden comes news of two important electronic developments.

Of special interest to industrial enterprises, insurance companies, scientists and others, is a computing machine, claimed to be the world's quickest operating machine of this nature. Quick to take advantage of this latest aid is a group of meteorologists engaged in evolving new methods of obtaining speedier and more accurate weather forecasts.

At the inauguration of the new laboratory building for the Swedish Institute for Preservation Research at Gotenborg, demonstrations were given of the use of very short radio waves and other novel methods of food preservation by electronic control. Both simple and quick, this method of preservation consists merely of exposing the cans containing the food to the source of radiation for a period of three or four minutes.

B.B.C. ORDERS TELEVISION TRANSMITTERS FOR CRYSTAL PALACE

WILL BE THE WORLD'S MOST POWERFUL TELEVISION STATION IN BAND 1

The B.B.C. has ordered both vision and sound transmitters from Marconi's Wireless Telegraph Co., Ltd., for the new London television station at Crystal Palace, which will replace the existing station at Alexandra Palace. The new station will take about two years to build.

When completed, the Crystal Palace will be the world's most powerful television station operating in the frequency band 42-88 Mc/s. It will also be the first time television transmitters have been used in parallel—on the same principle as the Third Programme transmitters which have been successfully operated for more than two years at Daventry.

The coverage given by this station is expected to be much larger than Alexandra Palace and will bring some of the existing "fringe" areas into full range.

Crystal Palace will have two 15 kilowatt vision transmitters designed for parallel operation with a combined output of 30 kilowatts. The effective radiated power of this station is expected to be between 250 kilowatts, which is twice that obtained from any of the existing regional transmitters. In order to achieve this the B.B.C. will, for the first time, use a high gain aerial system thereby utilising a transmitter output power which is only 10 per cent. of the regional transmitters.

The B.B.C. are also, for the first time, using television transmitters in parallel. Although existing standards of reliability and service are high, this arrangement results in an even higher standard since the failure of one of the transmitters results only in the lowering of the radiated power and not a complete shut-down of the station.

The vision transmitters are a new design built around a new type of tetrode valve being manufactured for Marconi's by their associates, the English Electric Co. Ltd., which simplifies the design and in consequence considerably reduces the physical size. They will occupy about a quarter of the floor space of those at Alexandra Palace and Holme Moss and about half the floor space of those at Kirk O'Shotts and Wenvoe.

The necessary adjustments to the transmitter are effected from the adjoining room. This room will be equipped with a special control desk incorporating controls for starting and stopping both vision and sound transmitters. The transmitter drive input and monitoring equipment will be mounted in the same room.

These transmitters are part of the latest range designed by Marconi's for the export market and can be used on either British, American or other standards. The two 4½ kilowatt sound transmitters which will also operate in parallel are being designed specially to meet the B.B.C's requirements since the B.B.C. imploy amplitude modulation.

"R & E" TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in. 3s. 6d; 8 in. x 6 in. 4s. 6d; 10 in. x 8 in. 5s. 6d. Please remit cash with order to RADIO and ELECTRONICS (N.Z.) LTD., P. O. Box 8022, Wellington, New Zealand.

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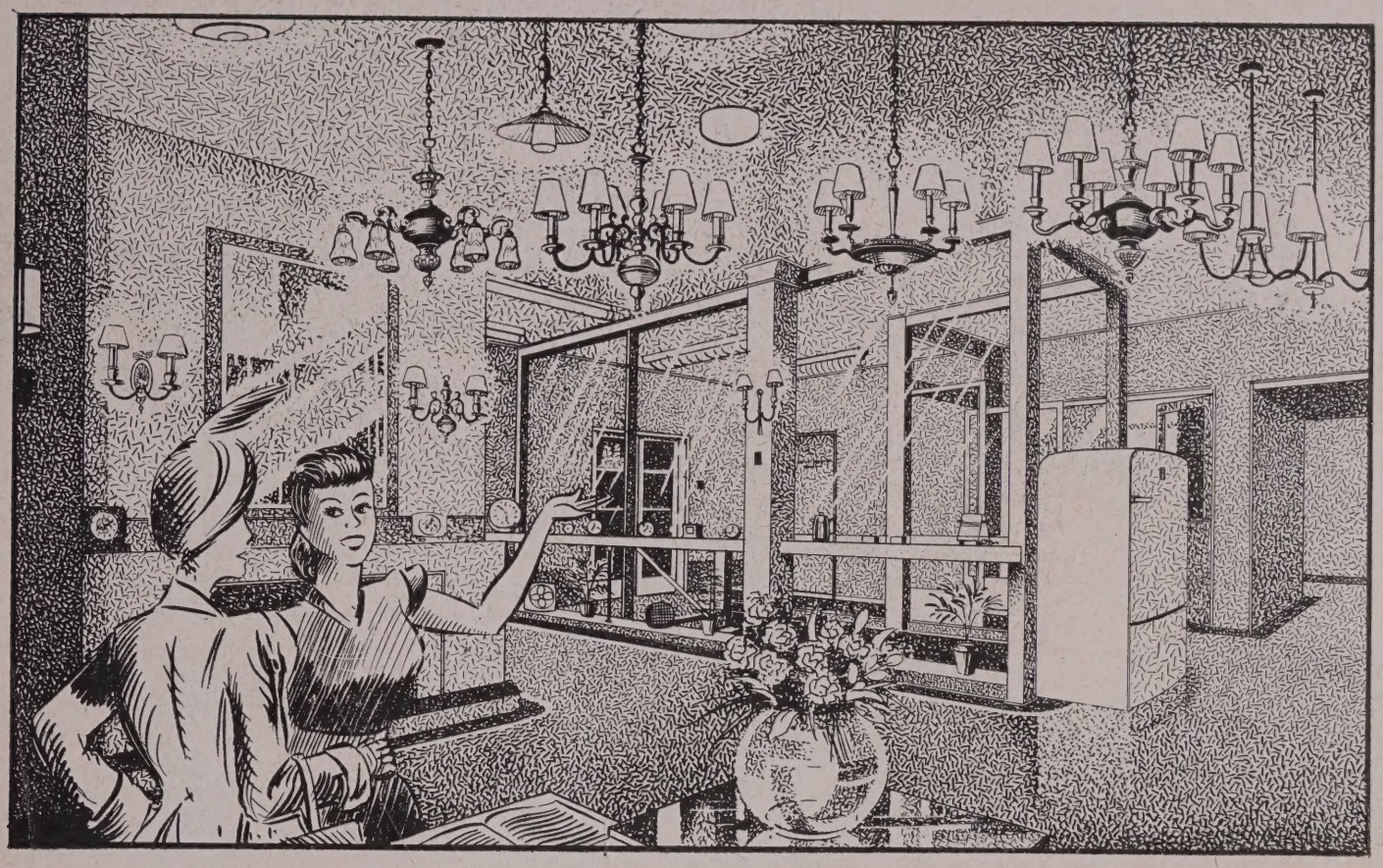

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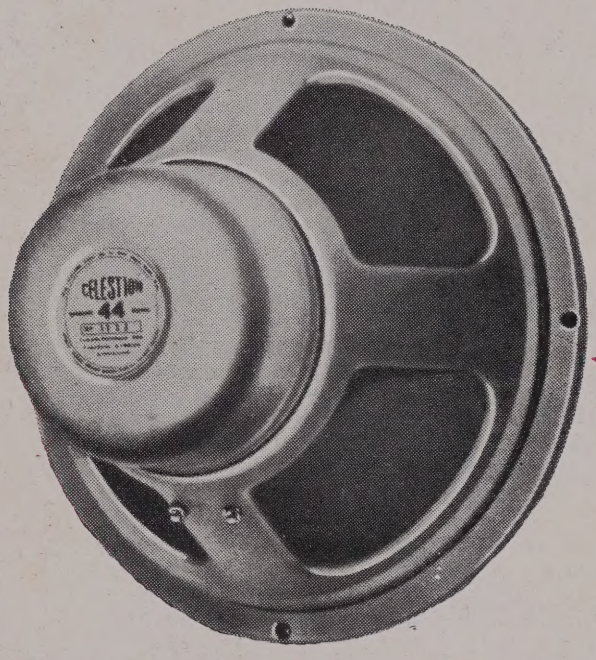

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